THE ENGINEER.

The British Industries Fair at Birmingham.

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THE British Industries Fair opens in London and Birmingham on February 20th and will close on March 2nd. In view of the importance of this Exhibition we propose, this year, to devote two Supplements to the description of some of the machinery, and of those Supplements the present is the first.

Following our practice, we confine our comments on the Fair to that section which is accommodated in the buildings at Castle-Bromwich, Birmingham, as that other part, which occupies the White City, London, is not of such immediate interest to engineers. We endeavour in this preliminary notice to give our readers some idea of the exhibits which they may expect to find at the Show; but it should be appreciated that the descriptions given in this Supplement do not pretend to cover anything more than a fraction of the whole Exhibition. They are taken completely at random and are the result of preliminary inquiries made amongst those exhibitors who were in a position to explain what they would be showing.

In the course of our inquiries we have been impressed by the optimistic attitude of the prospective exhibitors and their expressed intention of continuing to support the show. It must be remembered that this is essentially a trading occasion, when manufacturers are naturally chiefly concerned in displaying products which they are in a position to put upon the market at a competitive price. Hence technical novelties are not very conspicuous, but there are several examples in which considerable ingenuity has been brought to bear in the endeavour to attract attention to well-known appliances. The increasing interest of manufacturers is shown by the fact that the original buildings, at the old aerodrome, have had to be enlarged very considerably to accommodate the stands this year. Not only have the widths of the main structures been extended, but the long corridor which used to connect the "A" and the "B" rooms has been replaced by a new building, so that now there is a continuous roofed structure about one-third of a mile long by some 350ft. wide.

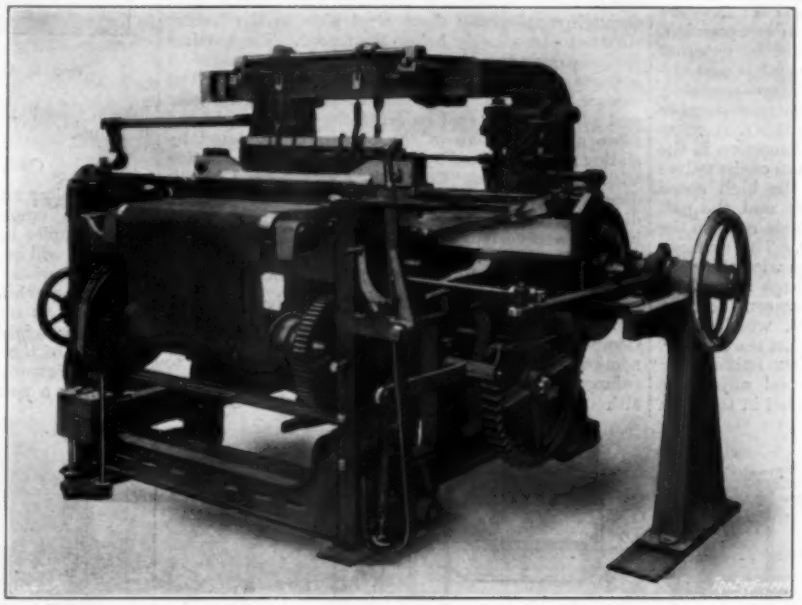
There will be, only naturally, a number of exhibits of purely engineering interest, and leaving aside those spectacular shows of brass pipes, chains and forgings, which may be impressive, but not very interesting to the engineer, we will proceed to describe some of the stands as we hope to see them on Monday next.

W. AND T. AVERY, LTD.

The case of W. and T. Avery, Ltd., Birmingham, is a typical example of the ingenuity referred to above. On their stand there will be little of the familiar show of machines. It will take the form, rather, of a series of tableaux intended to demonstrate the development of the art of weighing during the past three or four thousand years up to the time when, about a century ago, Avery's came into existence. And then, to bring the show "up to date" there will be a few examples of modern weighing and measuring machines. The historical period will be covered by means of six tableaux, and we have been privileged to inspect some of them in the making. As realistic efforts they are most convincing and represent such scenes as the weighing out of fish on a Phœnician vessel and mediæval market places, with all the detail most scrupulously portrayed. In this connection we have been assured by the exhibitors' "showman" that all these details have been copied from authenticated documents or pictures.

RD. JOHNSON, CLAPHAM AND MORRIS.

Among the various machines in motion at the Fair, one which will probably attract as much attention as any other will be the wire weaving machine on the stand of Rd. Johnson, Clapham and Morris, of Trafford Park, Manchester. This machine, which is illustrated by Fig. 1, is by the Anderston Foundry Company, of Glasgow, and is capable of weaving wire mesh up to 2ft. wide from wire of from 25 to 36 SWG. It is of the overpick, flying shuttle type, and is much the same in general construction as that described and illustrated on page 637 of our issue of December 5th, 1924. In it the let-off motion is positively driven by a multi-pawl ratchet fitted with a screw regulation and worm drive. The uptake motion is of the negative type, with a free-wheel ratchet box geared to the cloth beam, operated by a falling weight. The warp beam and cloth beam are of cast iron, while the breast and back rollers are heavy steel tubes. All the gear wheels on these looms are machine cut. On the same stand there will also be a wire-drawing machine in operation, and some specimens of wire netting, copper wire and concrete reinforcement.



[FIG. 1—OVERPICK, FLYING SHUTTLE WIRE LOOM—JACEM

THOS. R. ELLIN.

Any one of those enthusiasts who rode a cycle thirty years or so ago will remember the trade name of "Footprint" in connection with spanners. It stood then, as it still does, for the productions of Thos. R. Ellin, of Sheffield, who will be exhibiting a wide range of tools at the Fair. Our memories of "Footprint" tools are essentially connected with handy little shifting spanners, and we believe that the name became familiar through that product; but it stands for a much wider range of hand tools now, and is, perhaps, more generally associated with the lighter form of pipe grips. Besides a representative collection of spanners, grips, vices and clamps, the company will be showing a sort of museum in the form of some tools which have already served long terms and are still, nevertheless, in good workable condition.

WM. GRICE AND SONS.

The exhibits on the stand of Wm. Grice and Sons, Fazeley-street, Birmingham, may not strike the casual visitor as very interesting at first sight, but, on the other hand, feel assured that some conversation with the firm's representatives will be well repaid. The exhibits themselves are to comprise a couple of heaters for workshops and private houses, a wire nail-making machine, and some ingot moulds. The Minerva air heaters have already been described in our columns, and as little change has been made in their design, need not be described in detail; while the Birmingham style of nail-making machine is so well known as to need no description. It is, however, in connection with the ingot moulds on this stand that we think the greatest interest will be centred. These moulds are intended essentially for the production of non-ferrous alloys. Their peculiarity lies in the characteristics of the special iron from which they are cast. It enables them, so we understand, to withstand more than an ordinary number of casts without detriment or distortion; but the composition of this metal is, naturally, not disclosed to the casual inquirer.

E. GREEN AND SON, LTD.

The principal exhibit on the stand of this company this year will be a model of their vertical economiser with automatic scraping gear. Although other types of economisers have been manufactured in recent years by E. Green and Son, Ltd., the makers still recommend the standard smooth tube vertical economiser in cases where the exigencies of extremely high pressure, restricted space and maximum lightness do not exist. Modern power-houses, however, not infrequently present all the conditions just mentioned, and to meet them adequately, Green's have produced a new high-velocity gilled tube economiser, a full size section of which will be exhibited. The tubes are of smaller bore than those of the standard economiser, and are, therefore, much stronger. Closer spacing in the headers gives greater rigidity and compactness. Cast iron gills cast circumferentially on the tubes ensure a maximum amount of heating surface to be presented to the gases. An economiser of this type is, consequently, considerably smaller and lighter than a vertical economiser would need to be for the same duty. The economiser is constructed of a special quality of iron, which enables it to withstand the highest pressures commonly met with in modern practice. A steam soot blower, designed for use with this type of economiser, will also be shown. Radial arms throw out steam to all parts of the economiser, and fixed jets prevent the soot falling again on to the tubes. Mild steel casing panels for enclosing economisers have, we hear, almost entirely superseded brickwork, and a sample panel is shown on the stand. The panels are lined with a non-conductor and give easy access to the economiser for examination purposes. Valves and other economiser accessories will also be exhibited on this stand.

PULSOMETER ENGINEERING COMPANY, LTD.

The exhibits on the stand of the Pulsometer Engineering Company, Ltd., Reading, will be capable of division into three main classes, viz., pumps, refrigerating plant and filtering plant. Among the former it is, of course, unnecessary to mention the original Pulsometer steam pump, while several others will be almost equally familiar; but there will be among them the "Ring" pump shown in the drawing Fig. 2, which has been specially devised for handling comparatively small quantities of water—that is to say, quantities which do not justify the use of a centrifugal pump, against heads of 100ft. or so. A centrifugal pump is, naturally, not the most satisfactory appliance for raising small quantities of water, especially when the head is considerable. In such a case the efficiency is low and the pump will cease to deliver water should the speed of the motor fall below the rate necessary for the particular head. There is also the serious drawback that unless the gland is screwed up so tight as to cause risk of damaging the spindle a very small

leak, when working with a suction lift, may cause the pump to run dry and seize up. With these "Ring" pumps the high speed, from 300 to 500 revolutions per minute, at which they work makes it possible to drive them by belt or gearing from any ordinary electric motor, and if the speed should not be up to that specified, or if the speed of the motor should fall off on account of a temporary drop in the voltage or a reduction of periodicity, the pump will still continue to deliver water, only at a slightly reduced rate.

As will be seen from the drawing, the pump is of the single-acting reciprocating plunger type and is fitted with rubber ring multiple valves working on gun-metal seats. The valve seats for both the suction and delivery valves are made in one casting in the shape of a cage surrounding the plunger. The casting is retained in place by the end cover of the pump and can be readily withdrawn when the cover is removed. The valves are rubber rings working in V grooves in this casing, and in the bottom of each groove there is

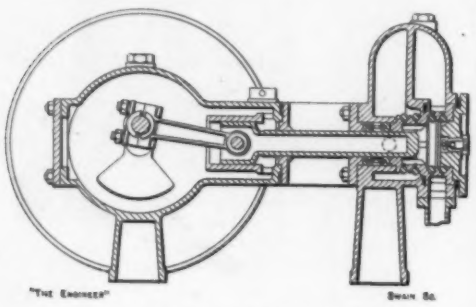


Fig. 2—Ring Pump—Pulsometer

a narrow slit, forming the water passage, which gives a large area and a free passage. The suction valves are placed in internal grooves and work in compression, whilst the delivery valves are placed in external grooves and work in tension. Both suction and discharge valves are of the same size and interchangeable. As the water passages are very large, the movement or lift of the valves is very small, and as this movement causes only a slight compression or elongation in the rubber there is practically no momentum of the valves to overcome. This feature makes the high speed practicable, and the small movement and the soft material from which the valves are made renders the pump virtually silent when working. The stuffing-box is fitted with two U packing rings with the open ends facing one another. They are kept in position by a distance sleeve and the space between the rings is exposed to the delivery pressure, which automatically keeps the packings tight against the plunger. The front of the valve casting enters the stuffing-box and forms the neck bush. A special adjustable snifting valve with a rubber ring is fitted in the back cover. The pump casing is provided with air vessels on both the suction and delivery sides to prevent water hammer and shock in the water passages. A boss fitted with a screwed plug is provided for the attachment of a bend with a cock and funnel for priming the pump if required. The pump casing is made in one piece with the enclosed crank chamber. The front part of the plunger, which is of gun-metal, is made to form a crosshead, with a large surface working in a bored crosshead guide in the crank case, to relieve the stuffing-box of the thrust from the connecting-rod. It is fitted with a crosshead pin lubricated from the crank case. The connecting-rod is of H section with a solid eye at the crosshead end and split brasses at the crank end secured with steel bolts. The crank shaft is of cast steel with balance weights cast on and is supported in bearings on each side of the crank. One end of the crank shaft projects through the crank case, where it is finished with a taper end to take the cast iron fly-wheel pulley, which is secured to the shaft by a key and nut. The crank pin and bearings on each side are lubricated by splashing from the oil in the crank chamber.

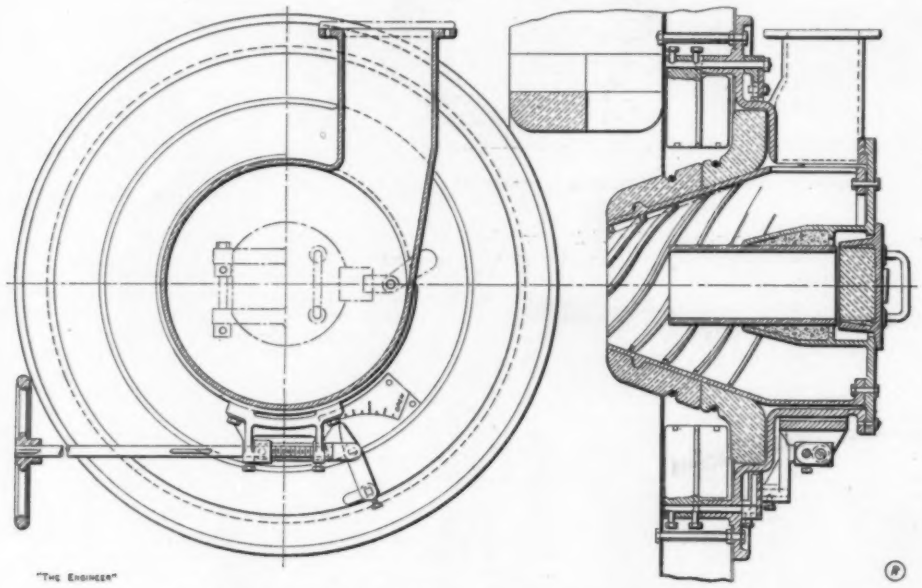


Fig. 3—Powdered Coal Burner—International Combustion

International Combustion, Ltd.

International Combustion, Ltd., of Africa House, Kingsway, London, W.C. 2, will have a novelty in the way of a new powdered coal burner; it is, in fact, so novel that the first example is not yet quite in practical operation, but will be so directly at the Walsall electricity works, where six burners are being fitted to three boilers, each of 75,000 lb. per hour capacity. This new burner is illustrated by the line drawing Fig. 3. It will be noticed that very effective means are provided for mixing the fuel and air together, and it is claimed that this mixture is exceptionally uniform, while only a low draught is required and the burner is adaptable to a wide range of operation.

On the same stand there will also be a new form of feeder for pulverised coal burners, which comprises a cast iron plate at the bottom of the bunker. This plate contains two apertures spaced diagonally. An agitator revolves over the top of the plate and distributes the pulverised coal through the apertures on to a rotor in the form of a star, revolving on the same shaft as the agitator. The coal is carried round by the rotor and passed through two smaller apertures in a lower plate. The coal falling through these apertures drops by gravity and is met by a current of air. This air is preheated, by passing it through ducts in the walls of the ash chamber, to prevent the coal packing through condensation of moisture. The air carries the mixture, which is practically a mechanical gas, through a relatively short steel pipe to the burner situated immediately below the feeder. The vertical shaft carrying the agitator and rotor is driven through a worm and worm wheel by an electric motor. The electric motor drives the worm shaft through a gear and pinion. The coal entering the apertures in the plate at the bottom of the bunker is regulated by sliding gates operated by hand wheels. In association with this company Coal Oil Extraction, Ltd., is demonstrating the K.S.G. process of low-temperature distillation, which aims at the production of a smokeless fuel and various liquid by-products.

Midland Saw and Tool Company.

We have, in the past, described the universal woodworking machine made by the Midland Saw and Tool Company, of Summer-lane, Birmingham, in connection with previous Fairs, so it is unnecessary to enlarge upon it here, but it is noteworthy that although the makers have endeavoured to build up a stock of these machines, they are disposed of so rapidly that they go out of the shops as fast as they are made. This machine, it will be remembered, combines the functions of a saw, morticing machine, planer and thicknesser all on one stand, and is one of the most compact woodworking machines we have seen. The company will, however, be exhibiting a new machine in the form of a 26in. circular saw bench with an unusually substantial framework and a canting turn-over fence. There will also be the band sawing machine illustrated by Fig. 4, which has wheels 22in. in diameter with vulcanised rubber treads. *Apropos* band sawing machines, we learned in conversation with the makers of these machines that there is one in the trial stages in this country which is capable of sawing plate steel up to, say, ½in. thick at a speed comparable with that common when working in wood without it being necessary to cool the saw artificially; but this machine will not be ready for showing at the Fair. The "Midsaw" Company's stand will also include a sanding machine or "linisher," as it is called in America, and a surface planing,

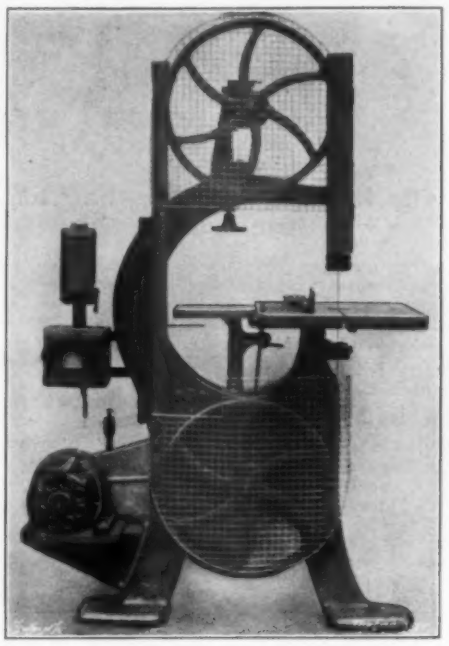


Fig. 4—Band Saw—Midland Saw Co.

jointing and moulding machine fitted with ball bearings.

Geo. Salter and Co., Ltd.

Geo. Salter and Co., Ltd., West Bromwich, means to every engineer, spring balances—there are two examples hanging in front of us as we write—but there will be at the Fair one of much more important dimensions than those we have in view. This weighing machine, of which we give an illustration in Fig. 5, is made in a range of sizes capable of sustaining weights of from 5 tons up to 100 tons. The principle of the apparatus needs very little description, in view of the line drawing. The load is supported by a pair of dished, tempered steel washers,

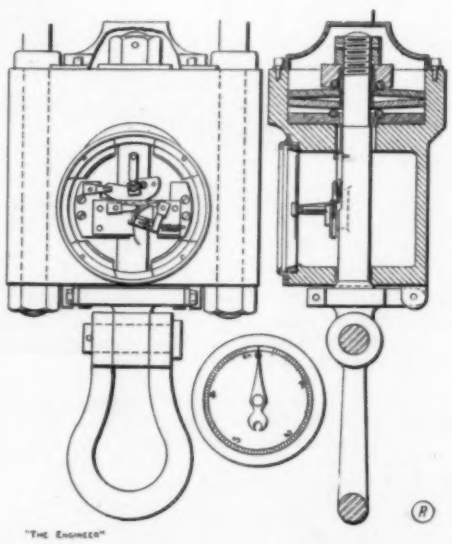


Fig. 5—Crane Weigher—Salter

and the flexure of these washers is a measure of the weight. The flexure is multiplied by the gearing shown, and is indicated on a dial, which is calibrated to read directly in tons and fractions thereof.

The cement testing machine—shown in Fig. 6—is of orthodox design, but has been revised and improved to meet the requirements of the British Standard Specifications Committee. In essentials it comprises a japanned cast iron column, carrying a pair of compound levers, having a combined leverage of 50 to 1. The levers are fitted with tempered steel knife edges, which rest on polished concave bearings, also of tempered steel, thus giving a very sensitive balance. A sliding balance weight for the purpose of setting the levers in equilibrium, is fitted to the upper lever. The upper clamp, to receive the cement briquette, is suspended from a knife edge on the lower lever; the lower clamp is attached to the base

of the column, and is adjustable by means of a screw and a small hand wheel. The supply of shot for applying the load to the bucket is automatically cut off at the moment the briquette breaks. In order to use the machine, the levers should be set "floating" by means of the sliding balance weight. Once set, this weight need not be touched. If, however, it is desired to start the load from zero, the weight can be adjusted to balance the weight of the can by running it out to the end of the lever. In that case either 50 lb. must be deducted from the scale when weighing the shot and can, or, to save this calculation, the pointer of the balance can be adjusted so as to stand at zero with the weight of the can, and in that case the pointer will give the weight of shot only. The briquette is next placed in the clamps, centrally and flush with

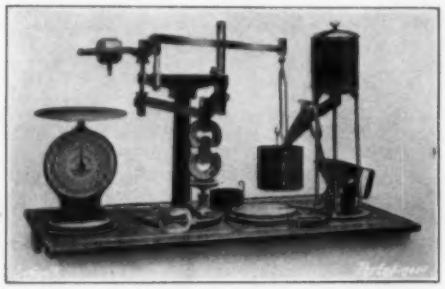


FIG. 6—CEMENT TESTER—SALTER

the sides. The next operation is to hang the bucket on the bridle and to screw up the hand wheel until the top side of the lever from which the shot can is suspended is about half an inch from the top of the guide. This then allows ample downward movement, if the clips slide up the briquette as the load increases, prevents the lever touching the bottom of the guide before rupture, and avoids the necessity of stopping the machine to screw up the wheel again. As soon as all is ready and all the knife edges are seen to rest square in their bearings, the handle for releasing the shot from the hopper should be depressed to the first notch. If starting from zero the shot should be adjusted to run at the rate of 500 lb. per minute. As soon as the briquette breaks, the bucket falls on to the rubber pad, depresses a lever and so cuts off the supply of shot. The bucket is then removed and placed on the spring balance, by which the breaking load is at once indicated without calculation.

TAYLOR AND CHALLEN, LTD.

Taylor and Challen, Ltd., Derwent Works, Birmingham, propose to have some presses at work, two of which will be making cigarette ash trays in

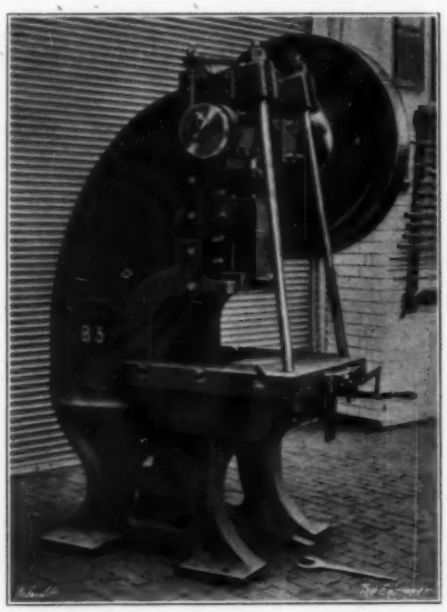


FIG. 7—PRESSING MACHINE—TAYLOR AND CHALLEN

stainless steel and brass; while another will be slotting out armature discs. These three machines are represented in Figs. 7, 8 and 10. It cannot be said that any one of these machines is novel at the Exhibition, but they are, nevertheless, interesting. The notching press, for instance, is to be shown running at a speed of 350 strokes per minute; but we are told by the makers that it has been run as fast as 600 revolutions per minute, and that even then the spacing of the slots was so good that a pack of stampings from the press, put together, appeared as if they were a solid mass of metal. Nevertheless it seems to us that the makers must use their ingenuity again to obtain the full advantage of this high-speed work, as, as things stand, the operation of feeding in the blanks is altogether the determining factor in the product of the machine. Or, to express matters another way, an automatic feed is required to produce the full benefits of such a machine.

In the making of the ash trays, already mentioned, two machines will be in service, one—see Fig. 7—for forming them and the other—represented in Fig. 8—for stamping on some lettering and forming the edges. The first, or forming press, is a typical example of one fitted with a pneumatic die cushion for holding the blank and allowing it to be pressed to

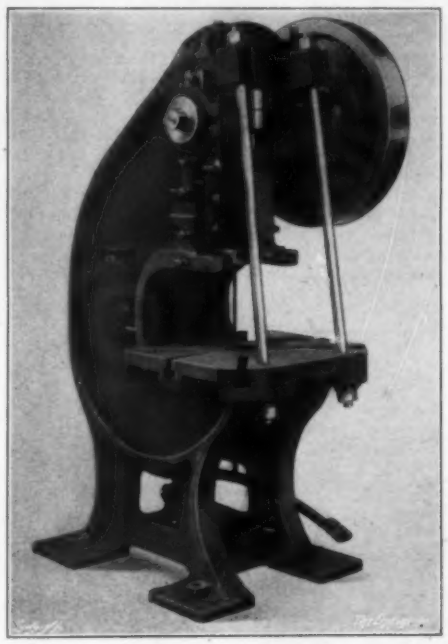


FIG. 8—PRESSING MACHINE—TAYLOR AND CHALLEN

form without the edges being puckered up. The blank is held between two grippers, the lower one of which is supported by pneumatic pressure. As the process of forming the article proceeds, from the flat blank, the material is drawn from between these grippers and is forced into the die. At the same time the grips must follow the tools downwards, and it is here that the pneumatic support shows its merit. It would, of course, be possible to support the grip by means of a spring or buffer, and such a scheme is not infrequently adopted; but the spring offers a gradually increasing resistance to the press, so that the job may be destroyed or the machine stalled. With the pneumatic cushion, however, the gripping pressure can be set to a nicety, and then remains the same throughout every stroke. The exactitude of this adjustment may be gauged from the fact that the one instrument will regulate the air pressure from 5 lb. to 100 lb. per square inch. The general con-

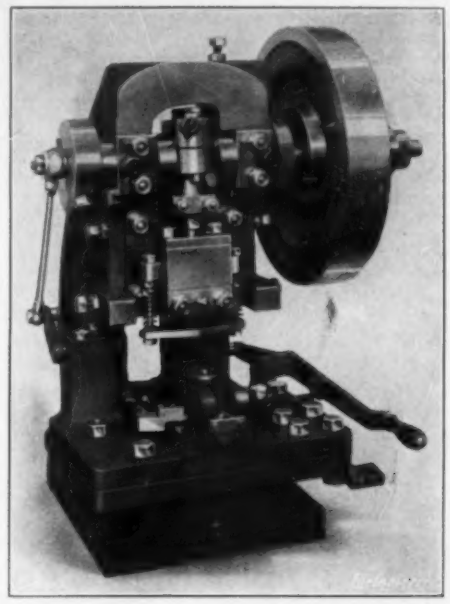


FIG. 10—NOTCHING PRESS—TAYLOR AND CHALLEN

struction of these presses is so familiar as to need no further comment here.

BRITISH OXYGEN COMPANY, LTD.

Most of the machines on the stand of the British Oxygen Company, Ltd., Angel-road, Upper Edmonton, will be shown in operation, and will include the universal blow-pipe cutting machine illustrated by Fig. 9. In general, the machine consists of a heavy base plate and work table supporting at one end a vertical column upon which is mounted a sleeve carrying the template holder and cutting arms. The machine depends for its working principle upon the attraction between a magnetised tracing roller and a steel or iron template. The cutting blow-pipe is mounted on the end of the frontal cutting arm, directly under the tracing roller, so that a common centre line passes through the cutting nozzle and roller. The tracing roller is magnetised by means of a coil surrounding the roller spindle. The magnetic

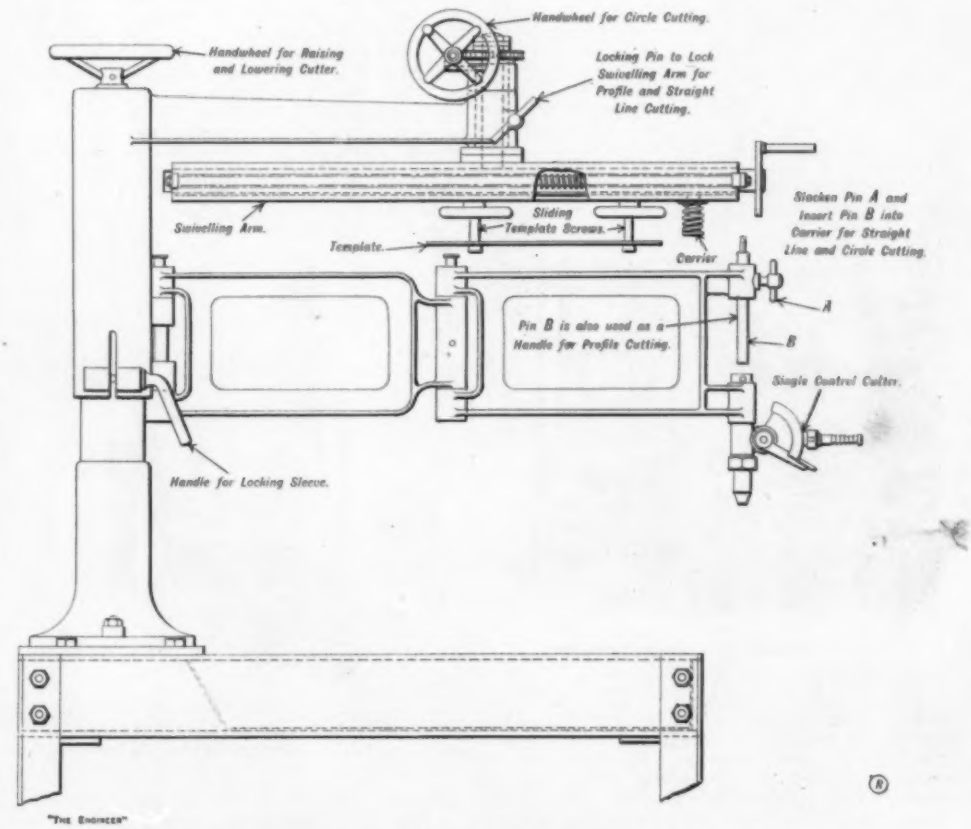

Handwheel for Circle Cutting.
Handwheel for Raising and Lowering Cutter.
Locking Pin to Lock Swivelling Arm for Profile and Straight Line Cutting.
Slacken Pin A and Insert Pin B into Carrier for Straight Line and Circle Cutting.
Swivelling Arm.
Sliding Template Screws.
Template.
Carrier
A
B
Pin B is also used as a Handle for Profile Cutting.
Single Control Cutter.
Handle for Locking Sleeve.
"THE ENGINEER"

FIG. 9—UNIVERSAL BLOW-PIPE CUTTING MACHINE—BRITISH OXYGEN

field thus created causes the roller to adhere to any steel or iron template. An electric motor, driving through a change speed gear-box and shafting, rotates the roller. It will thus be seen that when the roller

is rotating it will trace round any desired steel or iron template representing the shape to be cut, the rate of travel at all times being constant, independent of the template shape. The templates are mounted on a turn-table carrier sliding on an arm projecting over the bed of the machine. This arm may be swung aside to allow heavy or bulky work to be lowered on to the cutting table. A circle-cutting attachment can be provided, enabling circular cuts to be effected without a template. Provision is made on the machine for the reception of a special oxygen pressure regulator. The regulator is provided with a large diameter low-pressure gauge enabling the cutting gas pressures to be accurately adjusted. A high-pressure gauge for indicating the contents of the oxygen cylinder or battery is also fitted. An electrical heater is incorporated to prevent freezing of the regulator.

Besides the machine just described there will be a smaller replica of itself, a hand-driven circle, straight line or profile cutting machine with a capacity of up to 20in. in diameter, a machine for cutting holes in steel plate up to 2in. in diameter, and several other cutting machines for joists, tubes, &c.

Canning and Co., Ltd.

We have in the past dealt with the products, in the way of metal finishing machines, of Canning and Co., Ltd., Great Hampton-street, Birmingham, but on this occasion there will be some novelties, among which there will be the warm electro-plating apparatus shown in Fig. 11, the principle of which is to expedite the deposition of a nickel covering by maintaining the electrolyte at a fairly high temperature and so agitating it that the detrimental effects of this high-pressure working, which might otherwise develop, may be minimised. The apparatus necessary for working at these elevated temperatures can be fitted to existing electro-plating vats and is shown in the illustration. It comprises a rotary pump of special design for the filtering and agitating of the electrolyte, agitating and filtering coils in the vat, a filter head and bag, some method of heating the solution and a simple arrangement for moving the cathodes. Three methods of heating the baths are possible. Steam heating is the most convenient, but boilers, if not available, are expensive to install. Electric heating is simple but expensive to work. Gas heating with a geyser equipment or a gas-heated air circulation is quite reliable. It is common knowledge that a warm plating solution will work much faster than a cold one. This is apparent in the rate of deposition during summer and winter. Heating, indeed, is the handiest method of raising the conductivity of a solution. A solution raised to 90 deg. Fah. (32 deg. Cent.) will usually allow the use of a current density of three times that permissible at 60 deg. Fah. (15 deg. Cent.), but all solutions do not lend themselves to heating, as some develop faults which militate against their use at elevated temperatures. However, a "Nivo" nickel solution of 20 deg. Beaume, raised to 90 deg. Fah. (32 deg. Cent.), will, it is claimed, give at least three times the current density, which can be obtained at 60 deg. Fah. (15 deg. Cent.). In other words, deposits of equal thickness may be obtained in a third of the usual time. Heating alone will permit the use of much higher current densities and consequently shorten the time of the article in the bath, but the process cannot be continued indefinitely. It must be realised that if a bath be worked very fast the metal in the immediate neighbourhood of the cathode will be withdrawn quickly from the solution, while the solution round the anodes will be increasingly enriched and impoverished round the cathode. In time there will be two strata, or layers, of differing density solutions in the vat, and unless the density is equalised polarisation will gradually be set up, and the conductivity of the solution will fall. To overcome this difficulty agitation is necessary. Agitation serves a treble purpose; it tends to remove the bubbles of gas from the cathode—thus avoiding pinholes—maintains an even density and temperature of the solution throughout the vat, and prevents the impoverishment of the solution round the cathode.

If a solution is heated and agitated the question of cleanliness is one of paramount importance, as if it is slightly dirty and only the normal current density is employed the dirt may settle on the cathode, but there is enough time for it to fall off before the nickel is deposited in a sufficiently thick layer to imprison the dirt. In the case of rapid, warm and agitated nickel solutions the speed of the deposition of the metal tends to lock up any dirt in suspension in the deposit, the agitation of the solution bringing any dirt which may be lying at the bottom of the vat into close proximity with the cathode. The rough and non-homogeneous plate which results is not so perfect a protection to the base metal as would be a clean, coherent smooth coating, and it does not finish so readily. It drags on the finishing mop and it is extremely difficult to obtain a high lustre upon it. In order to overcome this trouble Messrs. Canning have instituted a system of filtration of the solution which works automatically with the agitation. The solution is pumped continuously through a filter bag fitted at the end of the vat, thus removing any matter in suspension which would cause roughness in the nickel deposited.

The electro deposition of chromium as a means of protection from corrosion of the baser metals has received very considerable attention from this firm for some time past, and although we are not at liberty to disclose precisely the process they have adopted, the illustration Fig. 12 shows that it has been brought to a practical conclusion. There will also be on this stand some electro-plating barrels and the "Otter" dryer shown in Fig. 13. This apparatus is intended for drying off the moisture of comparatively small articles which have been treated in a liquid bath and is peculiar in that no sawdust or other similar material is employed, so that there is no liability for small crevices to become choked up. The work pieces, as can be seen from the cut, are shot into one end of a circular dryer and are gradually drawn towards the outlet end by means of a rotating worm. The necessary heat is provided by a set of gas burners below which act both by radiation and by the sensible heat of the products of combustion in their passage towards the chimney in the centre.

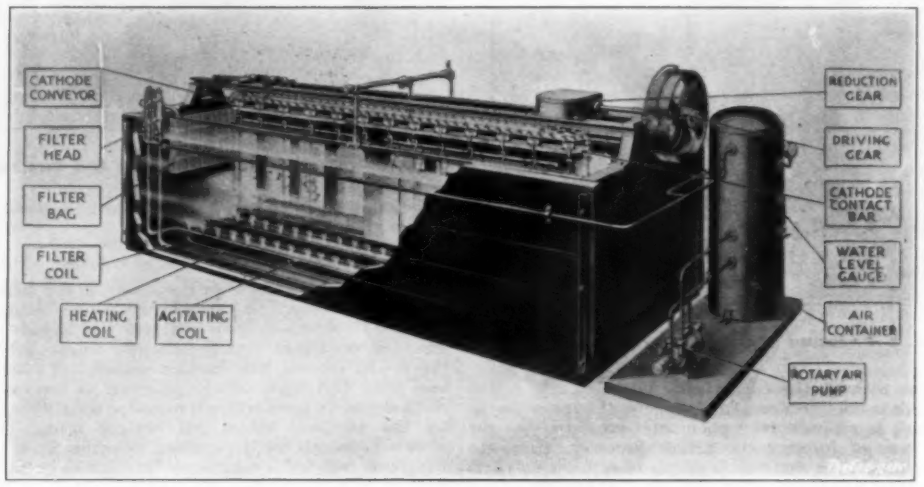


Fig. 11—Warm Electro-Plating Plant—Canning

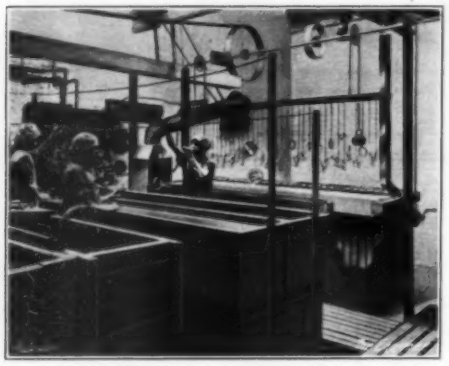


Fig. 12—Chromium Vats—Canning

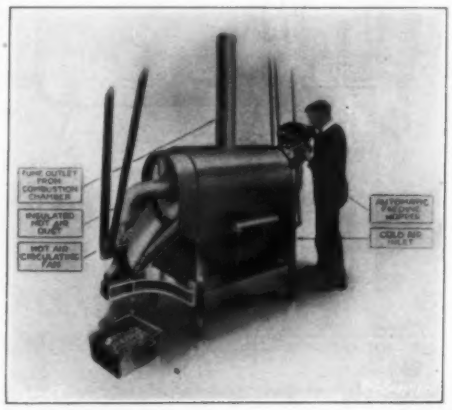


Fig. 13—Otter Dryer—Canning

Tangyes Ltd.

On the stand of Tangyes Ltd., Birmingham, there will be the familiar oil engines, pumps and lifting gear, among which latter there will be the two jacks shown in Figs. 14 and 15, but it is noteworthy that although in general outward appearance these exhibits may be familiar, there have been some improvements since the last Show. The heavy oil engine of the cold-starting type, for instance, has been re-designed and speeded up, so that it now develops 52 horse-power, as compared with the 47 horse-power of the engine shown twelve months ago. The speed is, however, kept down to 260 r.p.m. It will be interesting to see how this engine stands up to the trial of being run on no load during the period of the Exhibition, as such a run is one of the most severe tests of the completeness of combustion of its fuel. Another engine on the stand will be a 19 horse-power set, belt connected to a dynamo for the exhibitor's lighting.

In engines of this class one of the most vital features is, of course, the means adopted to spray the fuel oil into the combustion chamber, and in this case, in order to deal with various grades of fuel oil, the combustion chamber is fitted with a patented type of spray-maker. At the correct time the fuel oil is rapidly forced through the spray-maker by means of the fuel oil pump operated from the side shaft of the

Fig. 14—Hydraulic Ship Jack—Tangye

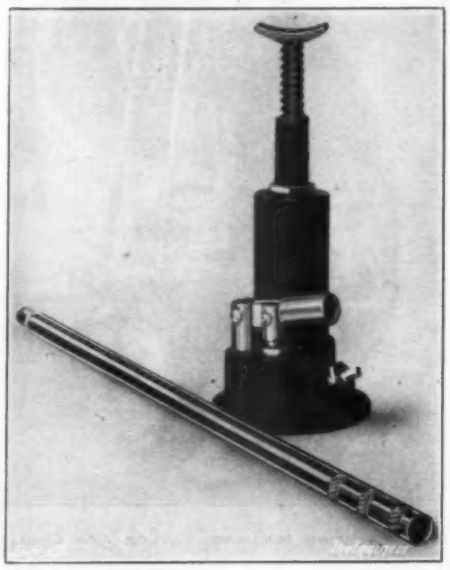


Fig. 15—Car Jack—Tangye

engine. At the moment the fuel oil has to enter the combustion chamber it raises a small piston and valve in the spray-maker against a strong spring, that then allows the fuel oil to pass through a pulveriser, which, having a number of fine tangential grooves, gives to the oil a rapid whirling motion, thus splitting it up into a fine spray or mist. It enables it to mix thoroughly with the compressed air and so ensures complete combustion upon ignition. The nipple of the spray-maker is of a particular construction—covered by a patent—which is claimed to prevent oil drip and the accumulation of deposit, when heavy low-grade fuel oils are used.

As to the two jacks on this stand, which we illustrate, little comment is necessary. The ship jack shown in Fig. 14 is made in eight sizes ranging in capacity from 12 up to 200 tons. It is of steel construction in general, but in the case of the larger sizes the ram is of cast iron with a wrought iron ring shrunk on and machined in place. The pump and plunger are of gun-metal. In the case of the car jack—see Fig. 15—it will be noticed that although the lifting effect is produced hydraulically, there is a height adjustment by means of a screw, so that packing up is obviated.

Among the pumps which will be exhibited on this stand there will be a treble ram vertical set capable of handling about 2350 gallons of water per hour, a series of little single-ram pumps, together with some centrifugal and turbine pumps.

PNEULEC COMPANY, LTD.

The Pneulec Company, of Mafeking-road, Smethwick, will be showing the foundry sand mixing or throwing machine illustrated by Fig. 16, to which we have made reference before; but the present example has been modified in one or two directions. The principle of the machine, it will be remembered, is that of projecting the sand off a fast-running inclined belt conveyor on to which it is shovelled by hand, so that the sand is mixed and arrested in its passage through the air and is dumped in a convenient heap on the floor. At the upper end of the conveyor it is necessary to provide some check to the direct passage of the sand, so that it may be churned over and thoroughly mixed before being shot forward. In the past models of this machine the check has been provided by a series of spring steel "fingers" almost touching the conveyor belt, but it has been found that the constant impact of the sand on the fingers has spoiled their elasticity, so that they got a permanent set and possibly allowed a piece of foreign material, such as a chaplet, to jam beneath and destroy the belt. For this reason the fingers are now each fixed on a pivoted casting—see Fig. 18—and are held up to the working position by a coiled spring in the box above. Another improvement in the new machine is the adoption of ball bearings throughout.

Other items of interest on this stand will be a system of cupola construction whereby the tuyeres are very easy of access, and a stove for heating core-drying ovens. The tuyeres for the cupola are not, as is usual, within the wind belt, but branch from it in a downward and inward direction, while they have the usual poking window at the bend. The result is that the attendant has a much better opportunity of attack with his poker, while it is virtually impossible for slag to bank up into the wind belt. The core-drying stoves, an example of which is illustrated by Fig. 17, are chiefly noteworthy on account of the fact that they are air jacketed. That is to say, the stove proper is surrounded by a second casing and air is admitted to the intervening space. The whole assembly is kept at an air pressure slightly above that of the atmosphere by means of a fan, and the secondary air, after having served its purpose in cooling the exterior of the stove, is mixed with the products of combustion to go on and help in warming the core ovens.

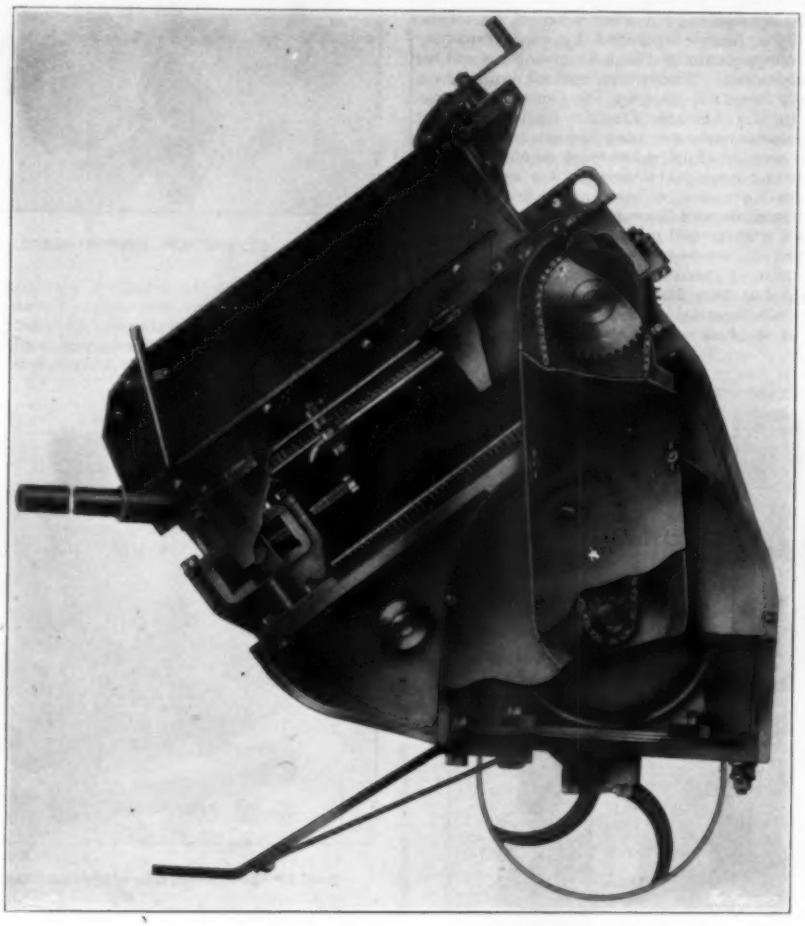


FIG. 16—SAND-MIXING MACHINE—PNEULEC

FIG. 18—PIVOTTED FINGERS—PNEULEC

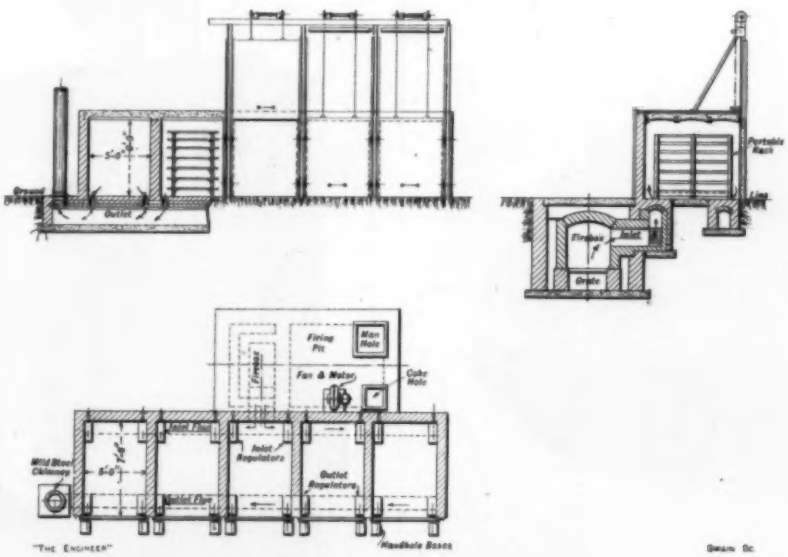


FIG. 17—CORE-DRYING OVENS—PNEULEC

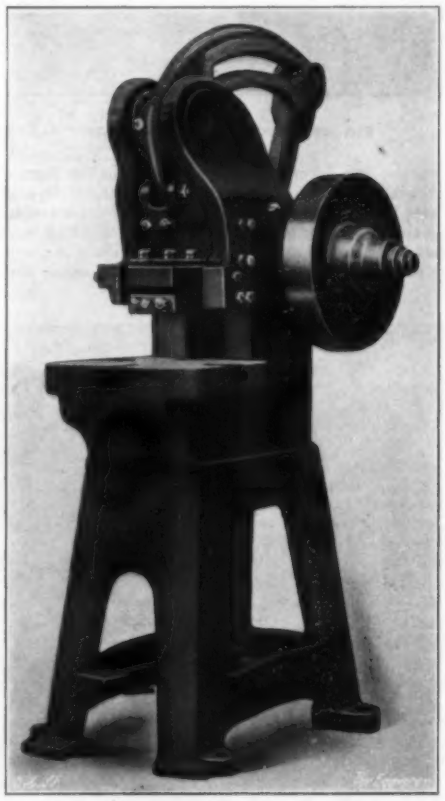


FIG. 19—TOGGLE PRESS—JACKSON AND SCHOFIELD

JACKSON AND SCHOFIELD, LTD.

The press illustrated by Fig. 19, which will be represented on the stand of Jackson and Schofield and is the invention of Mr. A. H. F. Perl, of Acocks

Green, Birmingham, is peculiar, in that the pressing action is produced by a combination of a rotary crank pin and a set of toggle levers, while there is provision for the alteration of the stroke of the tools after the machine has been set up. This adjustment is effected

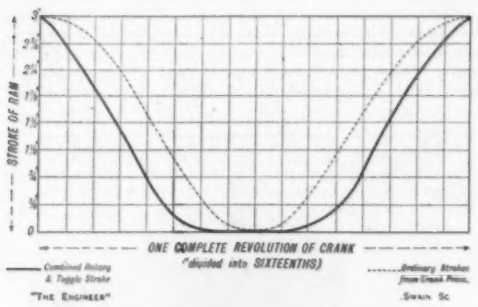


FIG. 20—GRAPH OF STROKE—JACKSON

with the help of the curved slotted lever plainly seen at the top of the press. This lever is curved to a radius struck from the centre of the crank shaft, and consequently any movement of the end of the connecting-rod in the slot does not affect the position of the tools. The lever is extended, much in the form of a bell crank, of which the short downwardly depending arm forms one member of a toggle joint for forcing down the operating tools. The result of this link work is that as the tools approach the bottom of the stroke they are gradually slowed up and at the same time a very powerful pressure is exerted, as is indicated in the graph, Fig. 20, so that as the drawing gradually becomes deeper the speed of the ram decreases. Again, by altering the length of the stroke, which is variable between ¼in. and 3¼in., the speed of the draw can be adjusted to suit the flow of several metals, in fact, the general arrangement of the machine is most adaptable, and with a gang of such presses any job can be passed along from one to the other in sequence, the strokes being varied to suit the sequence of operations on the particular job in hand.

THE GENERAL ELECTRIC COMPANY, LTD.

The three principal heavy electrical engineering exhibits of the General Electric Company are a 60 horse-power synchronous induction motor, an all-electric two-motor traction control equipment with a 240 horse-power traction motor as supplied to the London Electric Railways, and a 10 horse-power high-torque squirrel-cage motor with a contactor type star-delta starter operated by push buttons. The traction equipment and high-torque motor will be shown in operation. Ninety-five control equipments have already been supplied by the General Electric Company to the London Electric Railways. Six additional equipments are now being completed at the Witton works, whilst a contract recently placed with this firm covers sixty-three motor equipments and 107 trailer coach equipments. In all 1238 240 horse-power motors have been supplied, and the last contract was for 920 machines. The trains consist of three, six, or seven-car units, having respectively one, two, or three motor cars per train. Each motor coach has two 240 horse-power motors, and during the acceleration period they are controlled by means of resistances and the series parallel connections. The usual bridge transition system avoids momentary reduction in the tractive effort during the transition period. The main power circuit connections are controlled by means of "all-electric" contactors, shown in Fig. 21, which are, of course, operated by currents from the master controller to be seen on the right of Fig. 21. Every motor coach and approximately 50 per cent. of the tractor coaches are provided with a master controller so that train units of three coaches may be driven from either end. The acceleration is automatically controlled by relays carrying the main motor current. The control circuits for actuating the contactors pass through the relay and various sequence interlocks on each contactor, and these interlocks ensure that the contactors close in the correct sequence. The contactors also have change-over interlocks which change over the circuit of the contactor coil from the actuating wire passing through the relay to the retaining wire which is fed directly from the master controller. For the purpose of securing safety other interlocks are also provided.

Normally the circuit breakers are controlled on the remote control system from the driver's cab, but they can also be tripped and set by hand, and they are, of course, provided with an overload coil for opening the circuit at times of overloads. The twelve contactors to be seen in the centre part of Fig. 21 control the resistance steps and the series parallel combination.

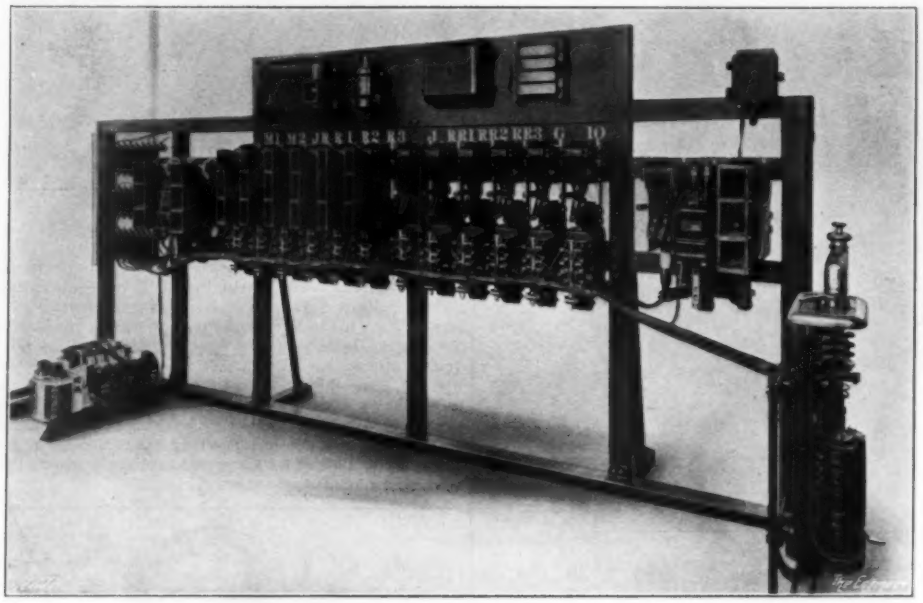


FIG. 21—CONTROLLER PANEL OF "ALL-ELECTRIC" CONTACTORS—GENERAL ELECTRIC

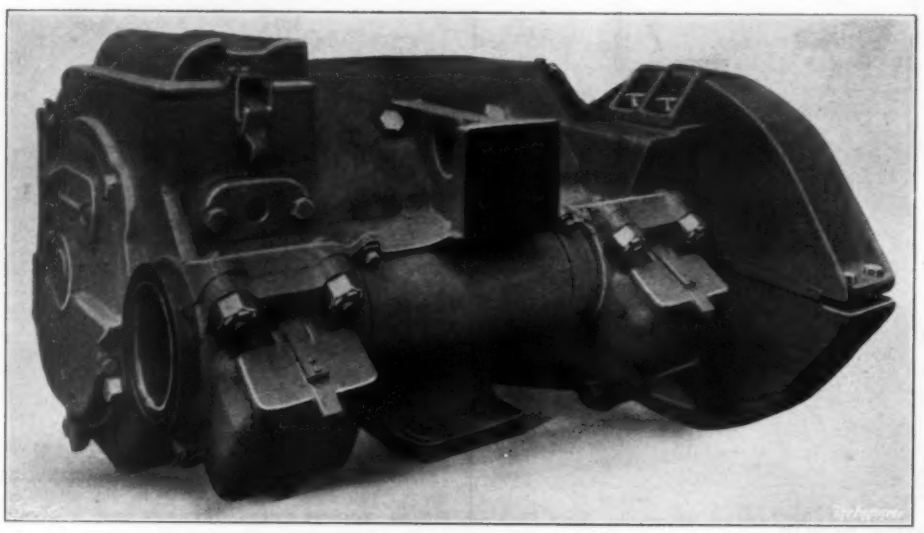


FIG. 22—240 H.P. TRACTION MOTOR—GENERAL ELECTRIC

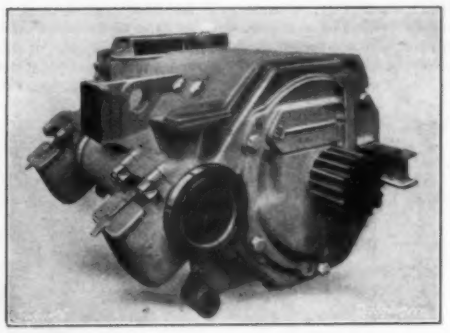


FIG. 23—240 H.P. MOTOR—G.E.C.

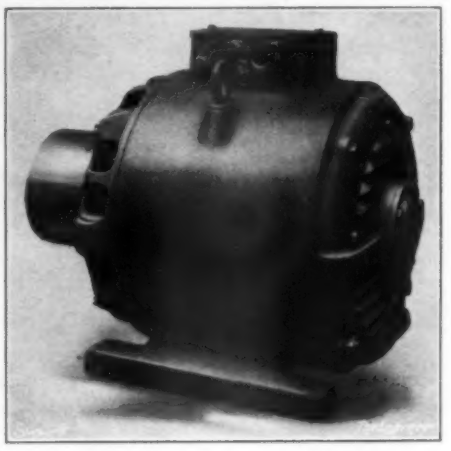


FIG. 24—SQUIRREL CAGE MOTOR—G.E.C.

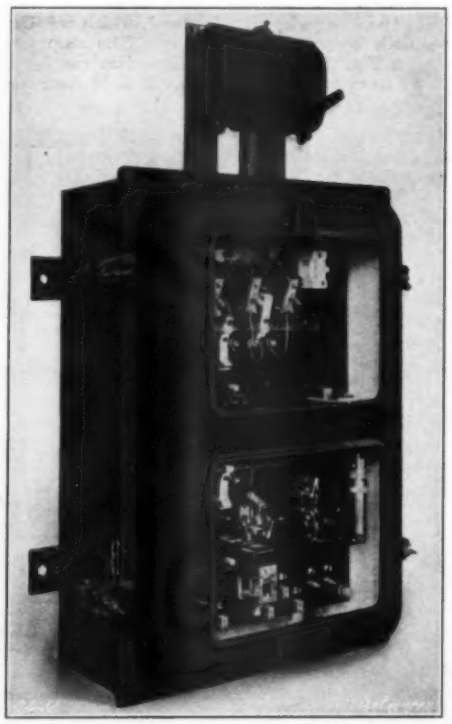


FIG. 25—STAR-DELTA STARTER—G.E.C.

The reverser, which is of the ordinary drum type, is electrically operated and is so interlocked that unless it is moved to the position corresponding to that of the master controller the main motor circuits cannot be energised. Primarily the master controller is designed for an automatic equipment.

Apart from the "off" position, the main handle can be placed in four positions. The first position gives the series connection with all the resistance in circuit and does not introduce automatic acceleration. This so-called switching step is used for handling the coaches in depôts, &c. As soon as the controller is moved to the second or "series" position, however, the automatic gear comes into action and the motors are accelerated under the control of the main motor current until the full series connection has been obtained. The third notch of the controller puts the equipment into parallel with all the resistance in

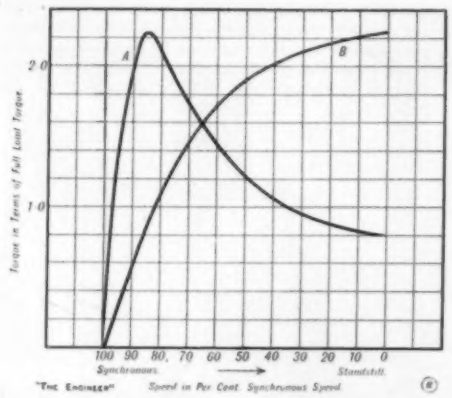


FIG. 25—MOTOR CHARACTERISTICS—G.E.C.

circuit, but it does not put the automatic accelerating relay into operation. When, however, the controller is moved to the fourth or parallel position automatic acceleration takes place under the control of the main motor current, until the full parallel connection is obtained. Normally the controller is moved to the full parallel position and automatic acceleration takes place. Apart from the fact that a slow speed can be obtained by moving the controller on to the first step, or the full series connection can be obtained by keeping the controller on the second step, automatic acceleration can be discontinued at any time by bringing the main handle back to the first or third

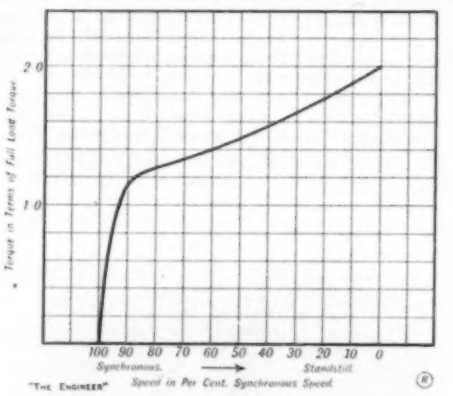


FIG. 27—MOTOR SPEED CURVE—G.E.C.

position. Thus in the case of emergency the controller has all the advantages of the hand-operated controller with all the added advantages of automatic features in ordinary service. One of the 240 horse-power motors is shown in Fig. 22, while Fig. 23 shows the machine from the pinion end.

The General Electric Company's high starting torque squirrel-cage induction motor shown in Fig. 24 will give, with auto-transformer starting, full starting torque when taking roughly twice full-load current. This is obviously a great improvement as compared with the performance of an ordinary squirrel-cage motor. The following table shows the

Method of starting.	High starting torque squirrel-cage motor.		Ordinary squirrel-cage motor.		Slip-ring motor.	
	Starting torque.	Starting current.	Starting torque.	Starting current.	Starting torque.	Starting current.
Switching direct on supply	Twice full load	Four to five times full load	120 per cent. of full load	Six times full load	Full-load torque	Full-load current
Star-delta starting	60 per cent. of full load	One and half times full load	40 per cent. of full load	Twice full load	—	—
Auto-transformer starting	Full load	Two and one-quarter times full load	—	—	—	—
Ratio: Starting current / Starting torque	$2\frac{1}{4}$ / 1		5 / 1		1 / 1	

starting performance of this new motor and also that of a slip-ring motor and an ordinary squirrel-cage machine. The rotors of these high starting torque machines have two windings. One of these windings has comparatively small high-resistance bars, whilst the other has low-resistance bars which are further away from the rotor periphery. It is well known that by building a motor on these lines it is possible to combine the features of a slip-ring and squirrel-cage motor and to obtain a good starting torque and reasonable operating conditions when the machine is running at full speed. The characteristics of a slip-ring motor with various resistances in circuit are shown in Fig. 26. The curve A shows the shape of the speed-torque curve when the slip rings are short circuited and when the resistance in the rotor circuit is at a minimum, whilst the curve B is a speed-torque curve with the resistance proportioned for maximum starting torque. The rotor windings of the high starting torque motor have characteristics corresponding to those shown by these two curves. The outer winding is arranged so that if it acts alone it exerts the maximum torque at starting and will give a speed-torque curve similar in shape to the curve B, which is obtained by making the winding of high resistance and low reactance. The inner winding, on the other hand, gives a speed-torque curve similar in shape to the curve A, because it has a low resistance and comparatively high reactance. By adding the torque exerted by each winding at various speeds the speed-torque of the high-torque motor is obtained and by altering the proportions of the two windings the resultant torque curve can be varied to suit the requirements of special duties. For general purposes the makers have developed a motor with a speed curve as shown in Fig. 27, where it will be seen that between no load and 25 per cent. overload the speed of the machine alters very little. In this respect the motor is similar to an ordinary induction machine. The characteristics over this range of load are identical with that of a direct-current shunt-wound motor. Above 25 per cent. overload, however, the speed falls more rapidly with increasing load, and within this range the characteristics correspond to some extent with those of a series-wound direct-current motor. For many purposes this is advantageous, as a fall in speed eases the load. Instead of falling out of step at times of heavy overload the speed of this high-torque motor is automatically reduced to suit the prevailing overload condition. The star-delta starter used for controlling the motor exhibited is shown in Fig. 25.

HOLLINGS AND GUEST, LTD.

A new exhibit on the stand of Hollings and Guest, Ltd., Thimble Mill-lane, Birmingham, will be the rotary pump illustrated by the line drawing Fig. 28.

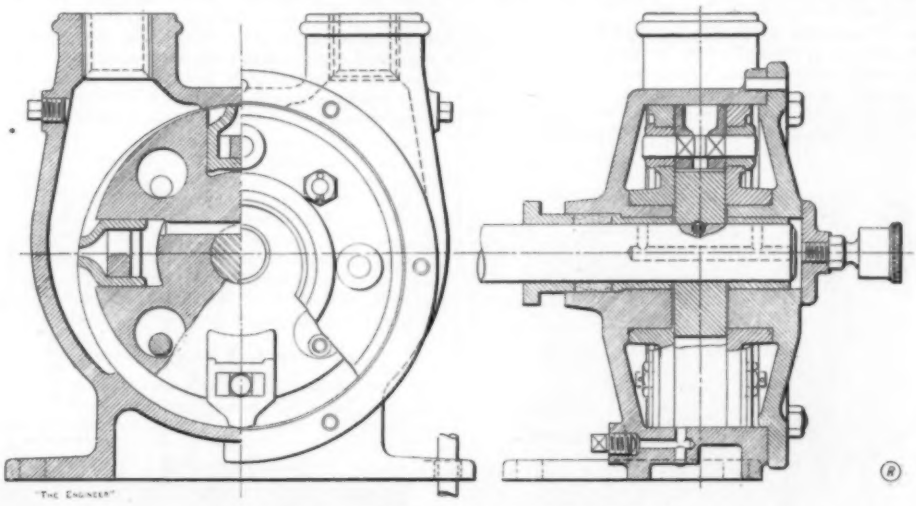


FIG. 28—ROTARY PUMP—HOLLINGS AND GUEST

It is intended for handling fluids of low viscosity, such as water and spirit, and industrial liquors of high viscosity, including fuel and lubricating oils, tar, molasses, &c. It is the outcome of long experience involving exhaustive tests and experimental work which had for their object the production of a pump of a superior efficiency and reliability, with freedom from the defects and limitations inherent in the design of some pumps of this class. Some test results which we have studied show that these pumps maintain a high degree of efficiency, ranging about 70 per cent., over a wide field of outputs, while the power-gallons curve is almost a straight line.

The hydraulic press shown in Fig. 29, also exhibited

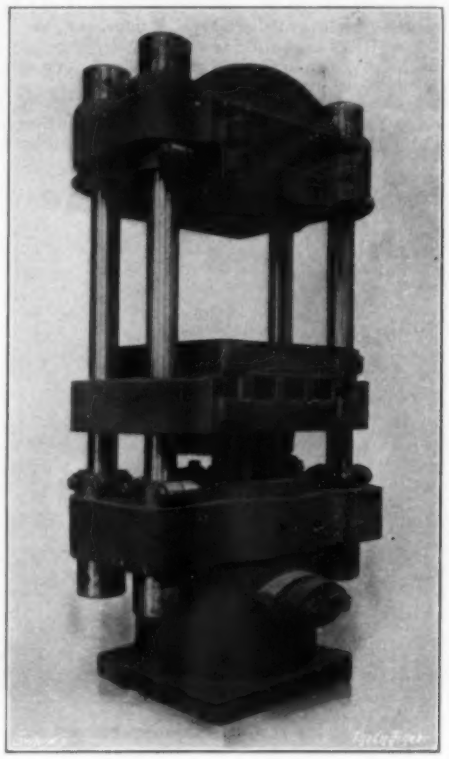


FIG. 29—HOT PLATE PRESS—HOLLINGS AND GUEST

on this stand, has been specially designed for the manufacture of insulating materials for the electrical industry. It is fitted with two hot plates made of cast iron in which the steam heating coil is cast solid, making it practically impossible for a fracture to occur at any steam pressure which may be reached in normal working. The hot plates in the standard press are 12in. square, machined on both faces, and polished on their working faces. The top hot plate is firmly fixed to the press head and the bottom hot plate is attached to the press table. The cylinder and base of the press are of cast iron, bored and faced for the columns, machined to receive the ram, and fitted with a hydraulic packing. The ram is of mild steel, machined and polished on its working surface and spigoted into the table. The table is a strong iron casting recessed to receive the ram and provided with guides which are a sliding fit on the columns. The table is insulated from the bottom hot plate so as to prevent the hydraulic packing from being damaged. There will also be on this stand a hydraulic tire press capable of exerting a pressure of up to 200 tons, a bundling press, and some examples of moulding work carried out in Bakelite materials.

PETTERS, LTD.

Petters, Ltd., will be showing a comprehensive range of oil engines, embracing the products of the Yeovil and Ipswich works. Among the Yeovil-built engines we have chosen for illustration two examples of single-cylinder vertical engines, which are representative of up-to-date Petter two-stroke cycle practice. The

engine shown in engraving Fig. 30 has a bore of 8in. with a stroke of 9in., and is designed for an output of 18 to 21 B.H.P., at 450 r.p.m. Two fly-wheels are fitted, which, together with the two-stroke cycle of operation, ensure a very low cyclic variation, making the unit particularly well adapted for dynamo driving. To the left hand of Fig. 30 on the inside of the fly-wheel the centrifugal shaft type of governor may be noted, and the vertically arranged fuel pump which it controls. Near to the top of the cylinder is a compression release cock for use when starting.

Details of the engine construction are given in drawing Fig. 31, which is a vertical section through the 12/14 B.H.P. engine, to be shown in operation on

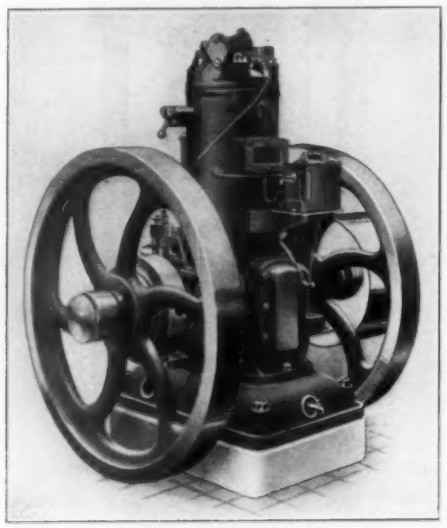


FIG. 30—18 H.P. OIL ENGINE—PETTER

the stand. It runs at a designed speed of 525 r.p.m., and has a bore of 6¾in., with a stroke of 7¾in. Fig. 31 clearly shows the simple plate form of the air inlet valves on the crank case, and also the scavenge air and exhaust ports. Attention may be called to the special shape of the top of the piston which assists the scavenging process by directing the inflowing air around the cylinder and the combustion chamber spaces.

A circular form of combustion chamber is employed with a narrow throat, which is partly water cooled and partly shielded from air cooling. The fuel spray is directed towards the top of the chamber in the direction of the cold starting igniter plug. When starting, a patented type of combustible plug is

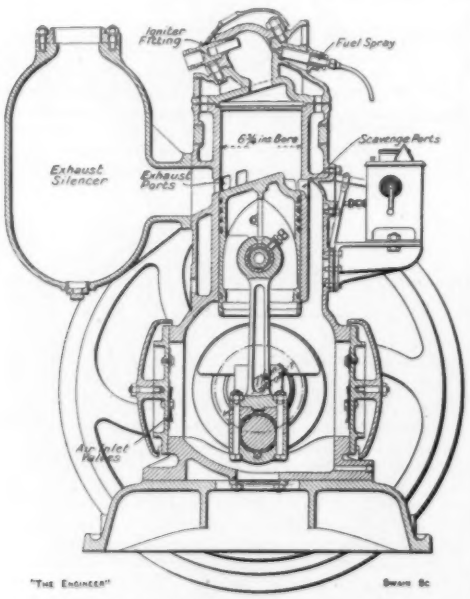


FIG. 31—12 H.P. OIL ENGINE—PETTER

inserted into the igniter fitting, and in burning provides sufficient heat to ignite the charge, and allow the engine to run up on load very quickly. Lubrication is effected by a mechanically operated lubricator, giving an economical consumption of about 0·02 pints of lubricating oil per B.H.P. hour. The guaranteed fuel consumption of these engines is about 0·55 pints per B.H.P. hour at full load.

In Fig. 32 we illustrate a two-cylinder marine type Petter engine, which is supplied for driving propellers, and is also specially suitable for marine auxiliary work, such as generator and compressor driving. Although similar in character to the engines we have already described, this model possesses particular features. The dimension from the centre line of the crank shaft to the engine bearers is small, and the 6in. diameter cylinders, with a stroke of 5½in., give a low engine. The engine we illustrate with the aforementioned cylinder dimensions, is designed for an output of 18 B.H.P. at 600 r.p.m. It is mounted on a continuous bed-plate, which also carries the direct driven auxiliary pumps and the reverse gear. The cylinder heads are specially designed for running under a wide range of loads without adjustment, and by means of large inspection doors in the crank case access is given to the working parts. The twin-cylinder model we illustrate is the smallest of three engines, all designed to run at 600 r.p.m. The three-cylinder model has a rated output of 27 B.H.P., and the four-cylinder unit 36 B.H.P.

Other engines to be shown on the stand include a 5 B.H.P. single cylinder unit direct-coupled to a generator for electric lighting service, and a 5 B.H.P. engine with high-tension magneto ignition using petrol and

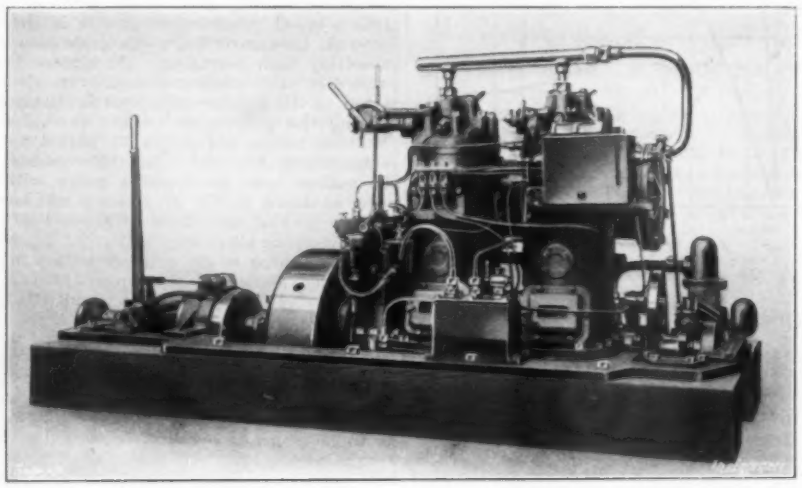


FIG. 32—TWO-CYLINDER MARINE ENGINE—PETTER

paraffin fuel, which type of unit is built in various sizes, both for stationary and portable use. Another model is a 3 B.H.P. hopper-cooled petrol engine for farm and general service work. Examples of the new "Calibrater" forced feed lubricator are to be shown. We have already dealt with them in the issue of THE ENGINEER for December 9th, 1927. They are now a standard fitting on the all surface ignition type of engines built by the firm.

The products of the company's Ipswich works will be represented by a twin-cylinder vertical two-cycle heavy-oil engine, arranged for belt driving. A section through which engine is reproduced in Fig. 33.

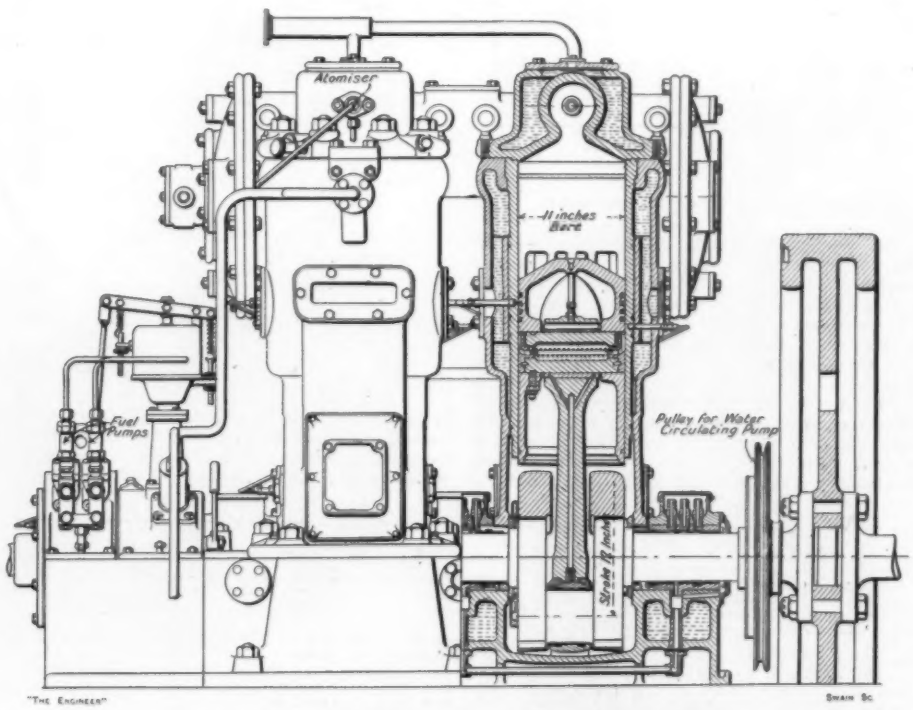


FIG. 33—TWO-CYLINDER STATIONARY OIL ENGINE—PETTER

This engine is one of the smaller units in a range of engines, with powers from 25 B.H.P. in the case of the smallest single-cylinder engine to 600 B.H.P. for the largest six-cylinder unit. Our drawing shows the principal features of the new design, which has already been described in our columns. The principal feature of the engine, it will be recalled, is the adoption of a completely water-cooled cylinder head and a medium compression, which gives a maximum cylinder pressure of about 400 lb. per square inch and moderate cylinder temperatures. The combustion space is circular in form, with a conical opening into the cylinder, into which the upper part of the piston passes. With the plain conical piston head, angled scavenge and exhaust ports are employed, which, we are informed, give good scavenging with a cool running engine and freedom from detonation at all loads. The air is taken in from below the bed-plate and passes into the crank case through plate type inlet valves, where it is compressed and delivered to the main cylinder. Special sealing rings are provided between the crank webs and the main bearings, which press lightly against the machined surfaces around the bearings, and effectually isolate the crank case from the bearings, thereby eliminating any loss of scavenge air. Oil is supplied to the cylinder and bearings by a mechanical lubricator, and on the main bearings a series of syphon wicks are fitted, which ensure a steady flow of lubricating oil, even though a slight variation in the oil level takes place. Arrangements are made to water-cool the bearings when required.

It will be seen from Fig. 33 that the fuel pump and governor unit is neatly arranged on an extension of the main bed-plate. A separate fuel pump is provided for each cylinder, and the supply of fuel to the atomisers is regulated by the governor, which controls the amount of fuel delivered to the cylinders, the timing being constant.

The fuel consumption is about 0·43 lb. per B.H.P. hour for the larger sizes of engine with a slightly higher consumption in the case of the smaller sizes.

The type of engine we have described is arranged for compressed air starting with electric heating plugs, or the firm's rapid starting burners working along with ignition tubes. More recently, however, a modified form of starting equipment has been success-

fully employed, which is simple and very effective. It entails the use of a length of about 4½in. of untreated plain round cotton wick about $\frac{7}{16}$in. in diameter, which is inserted in a special holder, so that about 2in. of the wick projects beyond the end of the holder. The wick holder is screwed into the cylinder head, in the connection provided for the ignition tube or electric plug, and is fixed by a left-hand locking nut. When the engine is ready for starting, the wick is lighted so that the end smoulders and glows brightly when blown upon. The wick holder is then inserted in the cylinder and locked in position, and the engine started on compressed air in the ordinary way. It is found that the heat of the smouldering wick is sufficient to assist the combustion of the charge, and to allow the engine to be run up to speed on fuel in a very short time. In addition to the two-cylinder engine we have described, a series of component parts will also be displayed by the Ipswich works, and will enable particulars of the constructional details of the engine to be gathered by those visiting the stand.

Automatic and Electric Furnaces, Ltd.

Various types of Wild-Barfield electric furnaces are to be exhibited on the stand of the Birmingham Corporation, by Automatic and Electric Furnaces, Ltd., of North-road, Holloway, N. 7. Three of these

FIG. 36—VERTICAL FURNACE—WILD-BARFIELD

furnaces will be shown in operation, one being a new horizontal furnace—see Fig. 34—with an arched chamber measuring 31in. long by 18in. on the flat floor, and 10in. to the arch of the roof. The furnace is fitted with a new type counterbalanced refractory door, and is provided with all the latest improvements. The current consumption is 15½ kilowatts, and with a normal charge the output of hardened steel is approximately 175 lb. per hour. The furnace is to be operated at the Exhibition by the Moss Gear Company, Ltd., which will send gears from the Wild-Barfield furnace at its own works to the Exhibition. There will also be a standard horizontal furnace with an oval-shaped chamber measuring 23in. by 16½in. by 6in. high. This furnace, which is to be operated by B.S.A. Tools, Ltd., has a current consumption of 7·2 kilowatts and an output of 68 lb. of hardened steel per hour. A standard vertical furnace—see Fig. 36—12in. in diameter and 23in. deep will also be shown. The current consumption in this case is 7·9 kilowatts, and the output of hardened work per hour approximately 74 lb. The furnace is to be operated by Charles Taylor and Co. (Birmingham), Ltd. There will also be a Wild-Barfield air temperature oven fitted with automatic control, which keeps the temperature constant within fine limits. One of the Wild-Barfield internally-heated furnaces will be seen in operation. These furnaces—see Fig. 35—are manufactured for use in connection with case-hardening, annealing, enamelling, &c., the furnace exhibited being used for enamelling. The heating chamber is 40in. long, 24in. wide and 12in. high. The energy consumed during the heating up process is 23 kilowatts. The furnace is fitted with automatic temperature control gear and a time switch, which brings the furnace into operation at any specified time, whilst the automatic temperature control gear keeps the temperature constant at any desired level. Experience is said to have shown that electric furnaces are much to be preferred to other furnaces for enamelling work, owing to the absence of sulphur and other deleterious fumes which tend to spoil the finished work. A soldering iron heater exhibited is provided with automatic switches, which automatically switch on more power as the irons are inserted into the heater, and the current is cut off automatically when the irons are removed. Various Wild-Barfield electric muffles for laboratory and works use are to be shown.

Ransomes, Sims and Jefferies, Ltd.

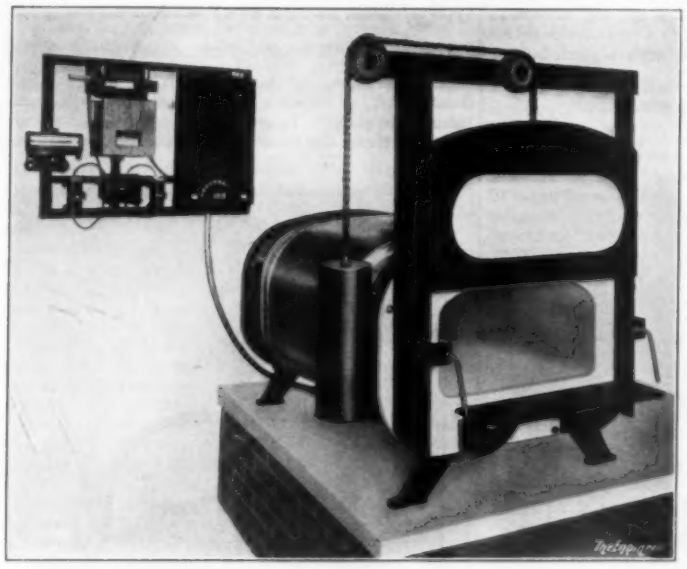
Electrically driven lawn mowers are among the exhibits of Ransomes, Sims and Jefferies, Ltd., of Ipswich. The 14in. machine shown in Fig. 37 is

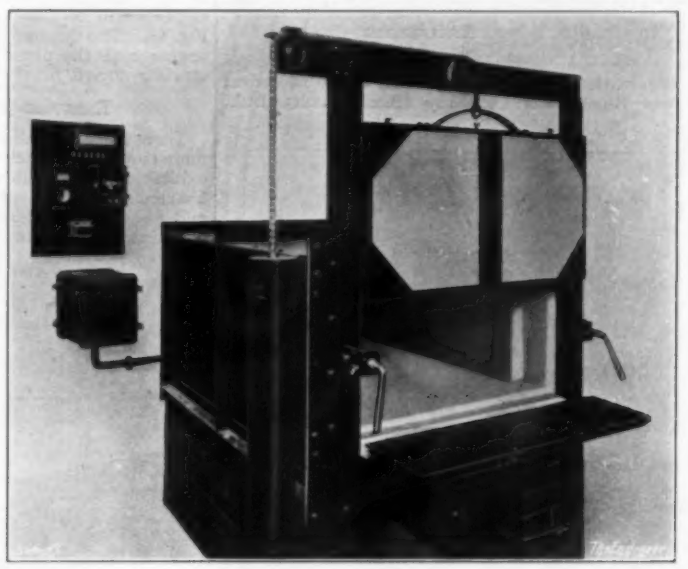
FIG. 37—LAWN MOWER—RANSOMES, SIMS & JEFFERIES

constructed on simple lines and is easy to operate. Current for working the motor is supplied by means of a long flexible cable, which can be placed on either side, so as to be clear of the machine whilst it is at work. A direct or alternating-current motor is provided according to the nature of the supply. Self-aligning dustproof ball bearings are fitted to the cutting cylinder and land rolls. The following is the makers' specification:—Motor, ½ H.P., alternating current or direct current, clutch control; clutch, single plate; transmission, roller chains and machine-cut gear; cable, 25 yards and connections supplied with each machine; width of cut, 14in.; approximate weight, 170 lb.; cutting cylinder, seven knives with hard steel cutting edges. A 16in. electrically operated lawn mower, a 2-ton electric truck, and alternating-current and direct-current motors designed for various outputs will also be exhibited.

Pritchett and Gold, Ltd.

All the leading accumulator manufacturers are represented and all the latest cells for lighting and wireless purposes, &c., are to be shown. A new "closed-top" cell for country house lighting is being exhibited by Pritchett and Gold and the E.P.S. Company, of 50, Grosvenor-gardens, Victoria, S.W. 1. One of these





FIGS. 34 AND 35—ELECTRO-MAGNETIC AND INTERNALLY HEATED FURNACES—WILD-BARFIELD

cells is shown in Fig. 38. The lid has an acid-tight joint, which enables the cells to be transported complete with the acid. When they arrive at their destination they are simply placed on their stands and connected up by means of special connectors which ensure that the connections are properly made. Owing to the fact that the cells can be sent out fully charged only a short freshening charge of about five or six hours' duration is necessary before they are put into service. Although the lids of the cells are

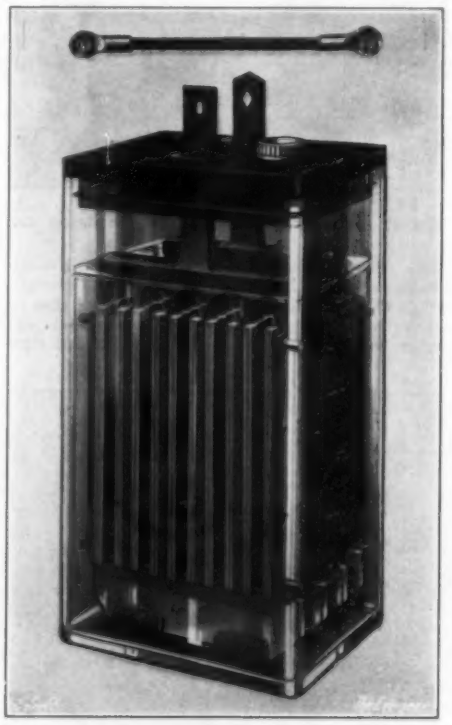


FIG. 38—ACCUMULATOR—PRITCHETT AND GOLD

provided with acid-tight joints, their removal is a very simple matter, and the elements may be taken out and examined without difficulty, for no sealing compound is used. The maker's anti-splashing vents enable water to be added and also permit the insertion of a hydrometer. The lids are made of impregnated teak and are fitted with rubber rings, which adjust themselves to irregularities in the contour of the box. A clear indicating mark on the glass case shows the correct level for the electrolyte. The positive plates are of the Planté type and the negative plates are box grids. Specially treated wood separators avoid short circuits occurring between the

plates. The bottom blocks are composed of glass slabs and are held in an antimonial lead frame which adjusts itself to any irregularities in the bottom of the box and distributes the pressure evenly. The bottom block has four bars and the positive plates rest on different bars from those supporting the negative plates, thus avoiding short circuits owing to sediment on the bars. For the collection of the sediment there is a space of 2in. at the bottom of the cells, and owing to the fact that the bottom blocks take up less space than usual a considerable amount of sediment can collect at the bottom of the cells. The cells, therefore, only need be cleaned out at long intervals.

Electrical Power Engineering Company (Birmingham), Ltd.

One of the most notable exhibits of the Electrical Power Engineering Company (Birmingham), Ltd.,

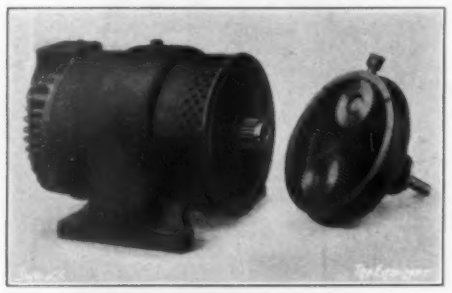


Fig. 39—Geared Motor—Elec. Power Eng. Co.

Ward End, Birmingham, will be the epicyclic geared motor shown in Fig. 39, which is claimed to run without vibration and to give a perfectly even torque on the low-speed shaft. The gearing consists of a gun-metal pinion which drives two steel or "fabroil"

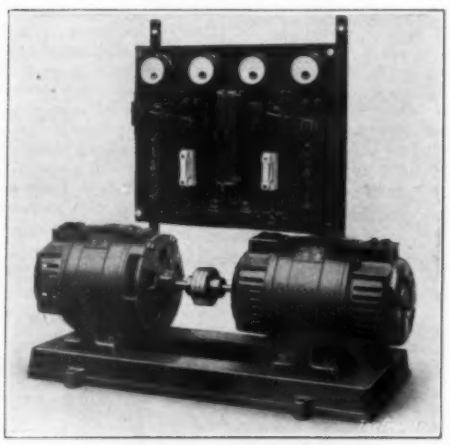


Fig. 40—Charging Set—Elec. Power Eng. Co.

planet wheels rotating in a fixed internal toothed wheel as shown. Ball bearings are used throughout and all the gears are enclosed. Motors of this type are supplied for a large number of shaft speeds which may be varied by altering the motor speed with a

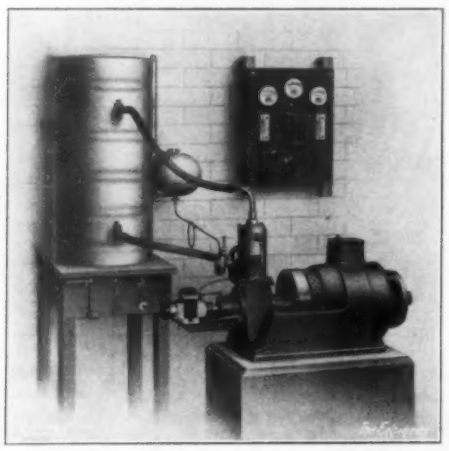


Fig. 41—Lighting Set—Elec. Power Eng. Co.

proportionate reduction in power at the lower speeds and an increase in power at the higher speeds. The constant potential battery charging set shown in Fig. 40 will be another of this firm's exhibits. It consists of a 230-volt direct-current motor directly coupled to a double commutator 8/16-volt constant-potential generator and a switchboard with the necessary instruments, &c. There are three bus-bars, and 12-volt batteries are connected across the "outers," whilst 6-volt batteries are connected to one of the "outers" and the middle wire. The connections to the bus-bars and batteries are made by leads with spring clips. Automatic cut-outs are connected in the charging circuits to safeguard the set and the batteries. Although the set exhibited is fitted with a direct-current motor, an alternating-current motor may, of course, be provided to enable the set to draw its supply from alternating-current mains. The constant-potential method of charging batteries avoids excessive gassing because the current falls off as the charging proceeds. Another of this firm's exhibits will be the Warwick lighting set, shown in Fig. 41. The dynamo is driven by a two-stroke petrol engine and the plant is fitted with a push-button starting device.

Electric Transmission Ltd.

Three firms specialising in electrical insulation and more especially extra high-tension insulation will exhibit goods on the same stand, namely, Electric Transmission, Ltd., of Dalston; Taylor, Tunnicliff and Co., Ltd., of Hanley, Staffs.; and the Micanite and Insulators Company, Ltd., of Walthamstow.

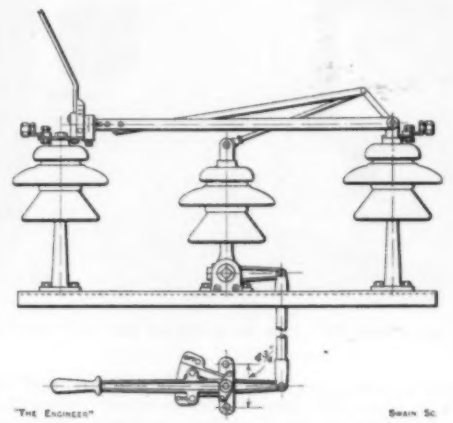


Fig. 42—Air-Break Switch—Electric Transmission

Overhead transmission line material will be shown by Electric Transmission, Ltd. There are insulators and switchgear and accessories, such as conductor and earth wire clamps, a combined danger notice and anti-climbing device, solderless line connectors, &c. The insulators are of the two usual types, namely, pin and cap, and pin and metal hood insulators. Pin type insulators suitable for working at pressures between 1 kV and 66 kV will be shown. Insulators of the cap and pin type are made up in strings of four and five insulators in series and fitted with double arcing horns suitable for a working pressure of 66 kV.

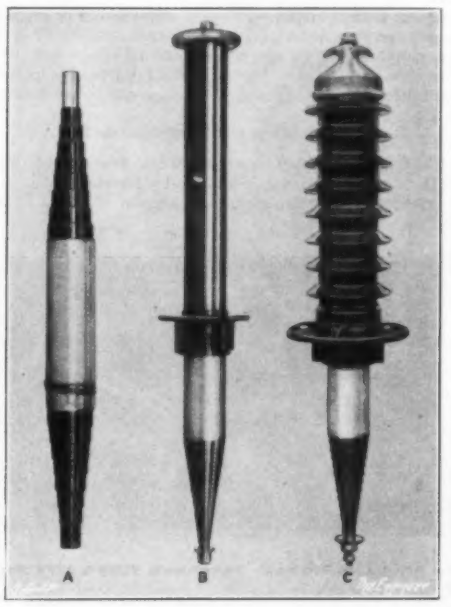


Fig. 43—Terminals—Micanite Co.

There will be strings of eight insulators with grading shields and arcing horns suitable for a working pressure of 132 kV. The air break switchgear is suitable for mounting in the open. Three pole switches will be exhibited for voltages up to 33 kV, and some air break and remote controlled isolating switches suitable for horizontal or vertical mounting. One of these switches is shown in Fig. 42. An interesting exhibit will be a porcelain outdoor type transformer bushing for working pressures ranging from 1 kV to 38 kV and suitable for use with transformers fitted with conservators. All the porcelain on the stand was manufactured by Taylor, Tunnicliff and Co., Ltd., who will also show independently of the two other exhibitors some large porcelain parts, such as the shells for 110-kV oil-filled transformer bushings, insulators for telephone and telegraph lines, &c. A comprehensive range of insulating materials is to be shown by the Micanite and Insulators Company. Mica and micanite for commutator end rings and a selection of insulators made from "Paxolin" will be among this firm's exhibits. There will be a range of condenser type insulators made by interleaving metal foil and "Paxolin." In Fig. 43 A is a 33-kV oil or compound immersed bushing, B an 88-kV. indoor type terminal, and C a 66-kV outdoor type terminal.

L.M. Magneto Syndicate, Ltd.

An interesting exhibit of the L.M. Magneto Syndicate, Ltd., of Victoria Works, Coventry, will be the pneumatic electric lamp shown in Fig. 44. Several types of these lamps are manufactured for different

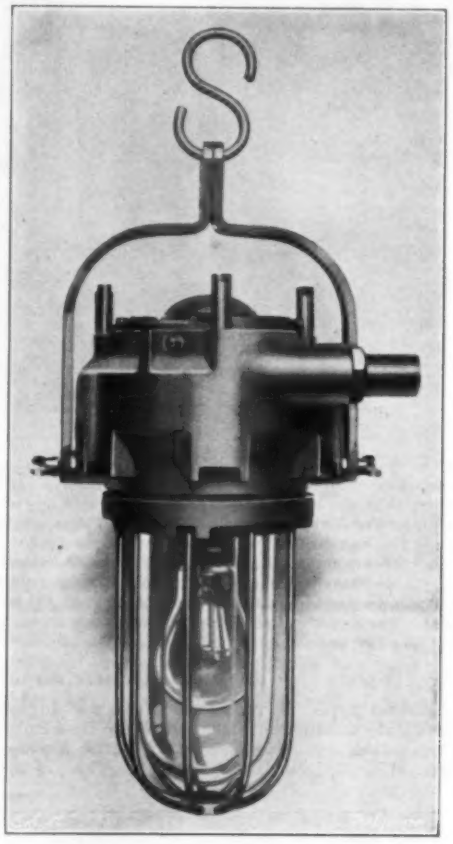


Fig. 44—Miner's Lamp—L.M. Magneto

purposes, but the most interesting is the high-power safety lamp illustrated, which has been passed by the Mines Department for use at any point in a coal mine, and which is said to be the only high-power lighting unit that can be used at the working face. The lamp, which gives approximately 100 candle-power, is combined with a small radial flow, compressed air, impulse turbine, directly coupled to a revolving field alternator, with a cobalt steel magnet, giving approximately 60 watts at 25 volts. There are no rubbing contacts. The whole of the casing containing

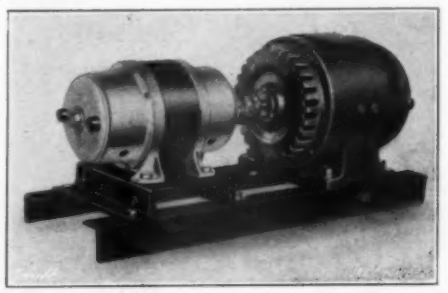


Fig. 45—Double-Current Generator—L.M. Mag.

the turbine generator and the lamp is maintained under a slight air pressure of 2 lb. to 3 lb. per square inch by means of a spring-loaded exhaust valve, thus preventing any possibility of infiltration of fire damp. An automatic device is also incorporated in the lamp for the purpose of short-circuiting the generator and cutting off the current in the event of damage or interference to the protecting glass over the bulb. The air consumption of the turbine is said to be very low. The firm will also exhibit small electric generators with permanent magnets, which

are very efficient, and owing to the absence of field windings the possibility of breakdown is reduced. The use of permanent magnets also makes the machines compact. The machines are supplied for a number of purposes. They may, of course, be used as small motors as well as generators. When working as generators they can be used for charging batteries and for operating electrical tachometers, and for giving a supply of power for wireless and similar purposes. Two machines, designated types E and F, have been designed to meet the demand for a unit which will supply a considerable plate current at a fairly high voltage and which are suitable for operating gramophone amplifiers, band repeaters, &c. These two models may be wound as rotary transformers or as single or double current generators. A motor double-current generator giving H.T. and low-tension supplies for wireless purposes is shown in Fig. 45.

GUTTA PERCHA COMPANY.

The magnetic alloys Mumetal and Rhometal, which have remarkably high magnetic permeability with very small magnetising force and high electrical resistance, will be shown by the Gutta Percha Company, of Wharf-road, City-road, N. 1, which will also show other special alloys. One of these alloys has been developed for use in audio-frequency transformers designed to give uniform amplification over the whole musical scale. Nickel-chromium resistance alloys will be shown for use in electric furnaces, radiators or other apparatus using wire, ribbon or cast resistors. These alloys are sold under the trade name "Pyromic." The alloy known as "Pyromic No. 1" is characterised by great strength at very high temperatures and has a long life at temperatures in the neighbourhood of 1100 deg. Cent., whilst the alloy known as "Pyromic No. 2" is a binary alloy composed of 80 per cent. nickel and 20 per cent. chromium. It is claimed to be the purest nickel-chromium alloy on the market. All these alloys are prepared in a high-frequency electrical furnace. A small high-frequency induction furnace is to be exhibited. Other exhibits will consist of instruments in which the firm's different alloys are used, a large electric radiator fitted with "Pyromic" ribbon and the different alloys in the form of sheet, castings and wire.

A. REYROLLE AND COMPANY, LTD.

A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne, will show a set of standard self-aligning fuses designed to comply with the Home Office regulations

FIG. 46—SELF-VENTILATING FUSES—REYROLLE

and suitable for working at pressures up to 660 volts. They have a separate hand grip which makes it impossible for live metal to be inadvertently touched. The fuse wires are enclosed in asbestos tubes fixed in separate chambers. When the clips are being fitted to the supporting panels, the self-aligning contacts save time and trouble, reduce the risk of cracking the porcelain, and by reason of the exceptionally good contact they provide, promote cool operation, which is also achieved by the self-ventilating properties of the fuses. The type of fuse shown in Fig. 46 is made in six sizes, which are rated at 30, 60, 100, 200, 350 and 500 ampères, and in each case the fuses are capable of clearing short circuits at a pressure of 660 volts.

Examples of the firm's air break switches in combination with fuses or plugs or both, and for use at pressures of 660 volts and for currents up to 60 ampères, will also be shown. All the combinations are made up in metal-clad form in waterproof boxes. The switches have a quick double-break on each pole, and they are constructed on very robust lines. When combined with fuses and plugs they are especially useful for controlling the supply of electrical energy to portable apparatus. The fuses are of the ventilated type, as described above. The plugs and sockets are for 30 or 60 ampères, and like the fuses they comply with the Home Office regulations. An additional pin is provided for connection to the separate earth conductor in the flexible cable. A waterproof joint is made between the plug and socket, by means of a screwed coupling ring on the plug, which engages with a thread on the outside of the socket. When the plug is withdrawn, the orifice of the socket may be protected by means of a screwed brass cap. The switch handle is interlocked with the plug, so that the plug cannot be withdrawn or inserted when the switch is in the "on" position. The interior of a 60-ampère, 660-volt, three-phase unit is shown in Fig. 47, whilst Fig. 48 shows a standard totally enclosed, double-pole, air-break switch, rated at 60 ampères at 660 volts. This class of gear is claimed to be eminently suited for industrial use where severe working conditions are met with.

Another Reyrolle exhibit will be a patented instrument for giving temperature indications at a distance. Its main object is to protect machinery working in automatic sub-stations, but it may, of course, also

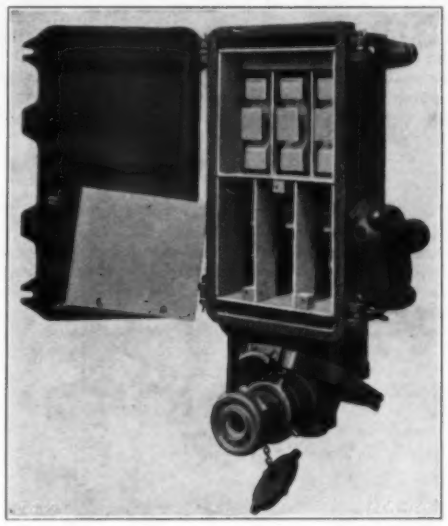


FIG. 47—THREE-PHASE SWITCH—REYROLLE

be used for protecting electrical machinery in other places. Its operation depends upon the change of shape with change of temperature of a metal strip in the form of a spiral. At one end the strip is anchored to the framework of the instrument, whilst the other end is free to give torsional motion to a brass rod attached to a lever. When the temperature of the strip changes, the brass rod and lever rotate, and the motion opens or closes circuits or performs other operations according to the object to be achieved. The strip and brass rod are contained in a tube and the operating mechanism is in the cylindrical portion shown in Fig. 49. Wires are taken to the external electrical circuit, through the flexible metallic tube

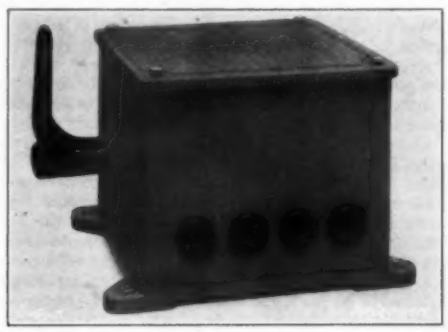


FIG. 48—DOUBLE-POLE SWITCH—REYROLLE

shown. When the instrument is used to indicate the temperature of a power transformer, the tubular stem containing the spiral is immersed in the transformer oil and a rise or fall in the temperature of the oil causes a movement of the lever, and if the temperature becomes too high the mechanism cuts the transformer out of circuit. If an instrument of the hand-setting type is used, the transformer must be inspected before it can be switched in again. A similar arrangement is used for protecting the bearings of electrical machinery. In this case, the tube is inserted in the oil of the bearing and the instrument shuts the machine down when the oil attains a predetermined temperature. In this case it is also usual to provide a hand-setting device, so that the machine can be inspected before it is put into operation again. A different arrangement is adopted when the windings of machines have to be protected against overloads. In the case of A.C. machines, the primary side of a current transformer is connected in the main circuit and the secondary circuit is connected to a heating element, whilst in the case of a D.C. machine a shunt is connected in the main circuit, and the heating element or the shunt is put into a containing vessel which also contains the tubular stem of the indicating instrument. The temperature of the containing vessel rises and falls in accordance with the current, and the position of the lever depends upon the changes in temperature in the machine. When suitably calibrated the temperature device works in harmony with the thermal conditions of the windings, and it can be made to switch out an overloaded machine or to give an alarm. The instrument employed for this service is usually self-resetting and operates by closing or opening the contacts of a relay circuit. The instruments are made to operate at any desired temperature, and the temperature range between shutting off and switching on again in the resetting type is capable of being varied within wide limits. The illustration—Fig. 49—shows a

FIG. 49—THERMOSTAT—REYROLLE

hand resetting type of instrument, with the cover removed.

HEWITTIC ELECTRIC COMPANY, LTD.

Among other things shown by the Hewittic Company will be a I.T. battery-charging rectifier for charging wireless and other batteries. Like all the Hewittic rectifiers, its action is based on the one-way valve action of mercury vapour in a sealed envelope. It converts alternating current at a certain voltage into direct current at the same or more generally a different voltage, and it comprises two components—the transformer and the bulb. The free ends of the transformer secondary—see Fig. 50—are joined to the anode electrodes of the bulb. The current enters

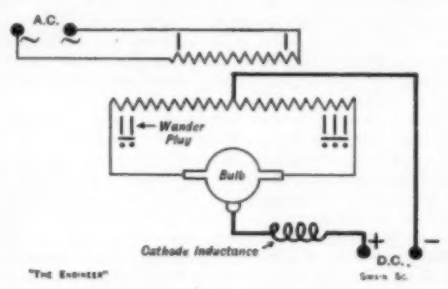


FIG. 50—RECTIFIER—HEWITTIC

the bulb alternately by one or the other of the anodes, but always passes in the same direction through the cathode, which constitutes the positive pole of the D.C. supply, whilst the middle point on the transformer secondary forms the negative pole. Full-wave rectification is obtained. In order to increase the inductance of the D.C. circuit and to reduce the pulsations, an inductance is connected in the positive lead, as shown. The rectifier is assembled in a sheet steel and expanded metal box, and the front panel forms the charging panel. On this panel a moving coil ammeter, a double-pole tumbler switch for controlling the incoming supply, the A.C. and D.C. terminals, and the voltage regulating control gear are mounted. By means of tappings, controlled by a wander plug on the secondary of the transformer, the pressure can be varied from 6 to 60 volts. A sliding resistance controlled by a knob provides fine regulation between the taps. The rectifier is started automatically by a high-tension discharge between one of the anodes and the cathode. This discharge is given by a coil which comes into action immediately the rectifier is energised, and it cuts itself out as soon as the rectifier begins to operate.

HACKBRIDGE ELECTRICAL CONSTRUCTION COMPANY, LTD.

A 2000-kVA single-phase oil-cooled transformer—see Fig. 51—will be one of the principal exhibits of the Hackbridge Electric Construction Company, Ltd.,

of Hersham, Walton-on-Thames. It is designed for a voltage ratio of 33,000/2250 volts, and by means of a Hackbridge tapping switch various voltages giving plus and minus 2½ and 5 per cent., can be brought into use. Another interesting exhibit will be the Hackbridge voltage regulating equipment, described in our issue of September 9th, 1927. This equipment, which is intended for giving voltage regulation on a feeder under load, will be shown in operation. On the Birmingham Corporation's stand the Hackbridge and

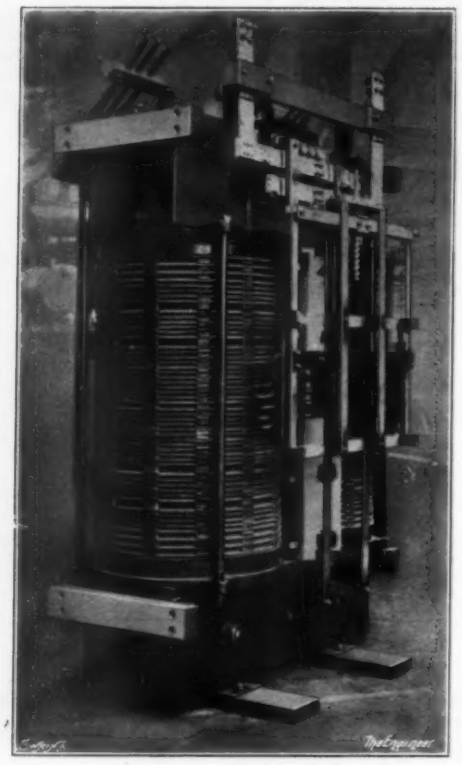


FIG. 51—TRANSFORMER—HACKBRIDGE

Hewittic companies are installing transformers and rectifying equipment for supplying light and power to the Exhibition.

CHLORIDE ELECTRICAL STORAGE COMPANY, LTD.

Sealed-in cells for house lighting are now supplied by most accumulator manufacturers, and amongst firms which will exhibit cells of this type is the Chloride Electrical Storage Company, Ltd., of Clifton Junction, near Manchester. This firm is also showing the older open type of cell. A complete battery for house lighting will occupy a prominent position on the company's stand. It consists of fourteen cells arranged on a double tier stillage, and its capacity is 200 ampère hours at the ten-hour rate. "Chloride Plante" and "Chloride Rosette" type plates will be on view, the capacity of the individual positive plates ranging from 10 to 450 ampère hours. Photographs of batteries containing these plates, with capacities up to over 10,000 ampère hours, are to be shown. Among the wireless battery exhibits there will be a 10-volt unit with a capacity of 5000 milli-ampère hours, assembled in a multi-compartment glass box. Any number of these units can, of course, be connected in series to form a high-tension battery. Forty and sixty-volt batteries of this type will be shown assembled in polished wood crates, together with a range of low-tension wireless batteries in celluloid boxes and cells in glass boxes. These cells are said to be extensively employed for operating electric bells, telephones, fire alarms, electric clocks, signalling circuits, and wireless sets of low current consumption. A new range of unspillable batteries in celluloid boxes for portable wireless sets, some batteries, and Exide Ironclad batteries for traction purposes, will be seen on this stand.

EDGAR ALLEN AND CO., LTD.

Edgar Allen and Co., Ltd., of Sheffield, will have a stand on which two of the most interesting items will be some specimens of high-speed steel and the pulveriser illustrated by Fig. 52. The latter machine, as will be seen from the illustration, is of the impact type; that is to say, the material to be pulverised is thrown by a series of rotary "hammers" against a fixed block and is then swept across a perforated screen, which will only pass such material as has been sufficiently reduced in size. A noteworthy feature about these machines is the fact that they are made of steel throughout, even to the extent of the fly-wheel being of steel, while all the parts subject to wear are made of manganese steel. The hammers with which the pulverising blows are struck are each connected with the driving discs by means of two looped lugs, and these loops are engaged by excentric pins. The excentricity of these pins allows the hammers to be adjusted for radial distance in four stages as they wear in service. The adjustment, we understand, can be effected in about twenty minutes. The direction of rotation of the hammers is counter-clockwise, as shown by the arrow in the drawing, so that the material being crushed first receives a blow as it drops down from the hopper and is then projected against the stepped block on the opposite side of the machine. In connection with this pulveriser there will also be shown a model rotary dryer in operation.

The new high-speed steel on this stand has been developed in order to utilise to the utmost the powerful cutting capacities of modern machine tools, and the makers consider that they have been successful—much in the same way as the competition between the armament maker and the armourer—in providing a tool steel superior to any machine in which it may be put in service. This steel is made in the high-frequency electric furnace, to which reference was made recently in our columns, that enables the mass of molten material to be kept in a constant state of agitation, and consequently ensures the thorough mixing in of the heavier constituents of the alloy. The stainless steel productions of the firm will be demonstrated in an unusual manner by a lych-gate forming an entrance to the stand and consisting of a roof composed entirely of Imperial stainless steel

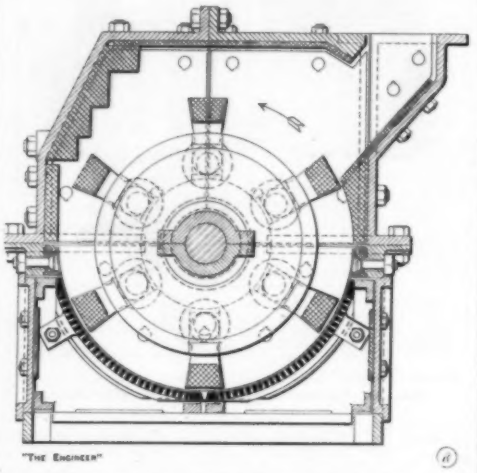


FIG. 52—COAL PULVERISER—E. ALLEN

plates supported on columns. From the descriptive sign, above, jets will spray water continuously on to the roof, thereby demonstrating in a practical way the non-rusting qualities of the material.

G. AND J. WEIR, LTD.

The display of Monel metal articles on the stand of G. and J. Weir, Ltd., of Cathcart, Glasgow, will show that this non-ferrous nickel alloy is finding a large and increasing use in the engineering, chemical and allied industries. The metal consists, it may be recalled, of 67 per cent. of nickel and 28 per cent. of copper, with an admixture of about 5 per cent. of other metals. It is mined as a natural ore at Sudbury, Ontario, Canada, and is produced by smelting under careful technical control, without separating the constituent metals. The subsequent refining is carried out by the International Nickel Company of New York. In the form of hot-rolled rods, Monel metal has a tensile strength of 36 to 42 tons per square inch, with an elongation of 36 to 50 per cent; while for hot-rolled sheets these values are 30 tons tensile and a 15 to 40 per cent. extension. In cast forms the metal has a tensile strength of 19 to 25 tons, with an elongation of 10 to 20 per cent. Cold drawing will, of course, greatly increase both the hardness and strength of the alloy, and a Brinell hardness of 237 and a tensile strength of 58 tons per square inch have been obtained by such treatment.

The examples to be shown on the stand comprise groups of articles made in Monel metal, which are employed in the textile, engineering and chemical trades, with other not less interesting applications in the shape of catering appliances, dairy equipment and hospital service utensils.

As an instance of the comparatively large types of chemical apparatus in which Monel metal now forms an important part, we may refer to a 6-ton autoclave designed for a working pressure of 150 lb. per square inch, which was recently fitted with an ¼in. thick Monel metal lining having welded seams. The steel shell had a diameter of 6ft. 3in., with a length of 10ft., and all bolts and pipe connections were made in Monel metal, as were also the cast arms of the stirrer and the tubular sheathing for the central driving shaft.

The firm also recently supplied a 1200-link Monel metal chain conveyor, for use in a salt works. Other uses of the metal in chemical works extend to centrifugal separator baskets and the pickling hooks and trays which are used in the plating and galvanising trades.

Considerable advances have recently been made in the production on a commercial basis of Monel metal condenser tubes, which have given, we understand, excellent service, both in naval and mercantile ships. Such tubes are now manufactured in lengths of 16ft. and with a thickness of about 20 gauge. Sample of such tubes will be displayed.

Messrs. Weirs are now making steam valves in sizes from ¼in. up to 9in., and liners are being produced with a wall thickness of ⅜in. and with diameters up to 12in. In turbine work Monel metal is employed in the form of blading, shrouding and garter springs for the packing glands. Examples will be shown of Monel metal utensils for dairy and hospital use, and of the applications of the metal to the varied requirements of domestic articles, internal decorations, stair treads, and ship, yacht, and train fittings.

H. W. WARD AND CO., LTD.

In accordance with the ruling of the Machine Tool and Engineers Association, Messrs. H. W. Ward and Co., Ltd., of Selly Oak, Birmingham, must not, like any of their associates, exhibit a full range of their products; but they have a stand on which there will be shown a number of small tools and attachments for capstan and turret lathes, together with the high-speed automatic chuck illustrated by Fig. 53. This chuck is operated by a lever at the front, and the action of this lever is directly towards the operator for releasing, and away for tightening. Fixed to this lever there is a pinion which actuates a sliding sleeve. Inside this there is a ball-operating sleeve, and the action of the outer sleeve forces an incline in the inner sleeve over a set of steel balls held in a ball cage. These balls give a longitudinal motion to a taper part fitting over a corresponding taper on the collet and so close it. The collet abuts against a cap which is adjustable to open or close the collet to allow for slight variations in the size of the bar. Once the

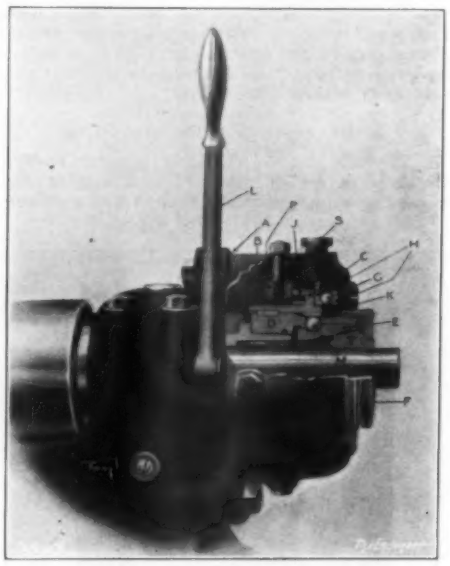


FIG. 53—AUTOMATIC CHUCK—WARD

collet is adjusted to size it is immovable longitudinally, thus ensuring uniformity in the length of articles made on the machine and also accuracy for second process work. The principal operating parts of the chuck are made of steel, hardened and ground. The only parts of the revolving mechanism touching any stationary part are two narrow faces, and these are provided with thrust washers to eliminate friction. In our illustration the ball-operating cage is shown at C and the ball cage at D. E represents the sliding cone sleeve, H and J thrust washers, M, of course, the balls, and T the collet proper.

EDWARD WHITE.

We have always been interested in the products of Mr. Edward White, of Redditch, as they cover a wide range of engineering, and savour somewhat of the art of the old-time millwright, but are, nevertheless, brought up to date by such machines as that illustrated by Fig. 54, which is one of several "wire" straightening machines which will be exhibited on this stand. The reason why we accentuate the term wire is that the machine in question will handle material up to ½in. in diameter, which can hardly be classed in normal parlance as wire, but will, nevertheless, take it from a coil and deliver it in really straight lengths of any desired dimensions within reason. The operating principle of this machine, which involves the pushing of the wire between a series of closely spaced rolls, needs no emphasis here, and can be followed out in the engraving; but it is noteworthy that the machine in question can be run at a speed of some 100ft. of straightened wire per minute. Incidentally, it may be mentioned that this

machine has been found quite satisfactory for cutting off lengths of wire cable.

On the same stand there will also be a machine for straightening and cutting off wire up to $\frac{1}{4}$in. in diameter and up to 20ft. lengths in two strands at once; a three-wire straightening and cutting-off machine for wires up to No. 10 gauge; and another one for rods up to 1$\frac{1}{2}$in. in diameter. There will also be several other machines for manipulating wire in one form or another, but as all these machines have been described in our recent articles on wire-working machinery, it is unnecessary to enlarge upon them here.

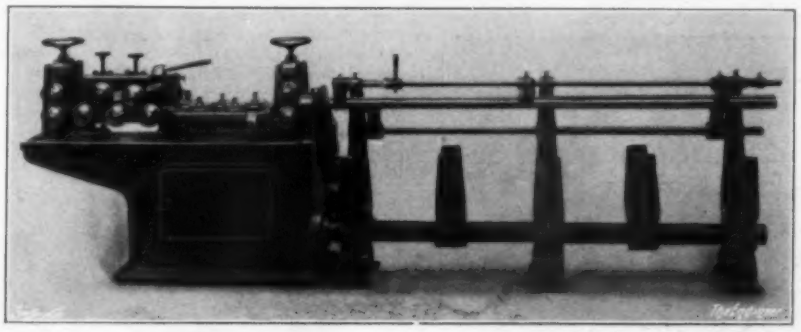


FIG. 54—WIRE STRAIGHTENING MACHINE—E. WHITE

GOODWIN, BARSBY AND CO., LTD.

Concerning the prospective exhibits on the stand of Messrs. Goodwin, Barsby and Co., Ltd., of St. Margaret's Ironworks, Leicester, we have had some interesting conversations, but, in view of the fact that quite recently we have dealt with some of the company's products in connection with the Public Works Exhibition, we shall not say much about them now. There will be, however, the stone breaker shown in Fig. 55, arranged in connection with a rotary screen or riddle. The particular feature of this machine is the throwing back of the main bearings to keep the fly-wheels as far back as possible from the mouth of the crusher. These bearings have also been tilted so that they take the thrust better than the old type of horizontal bearings. On this stand there will also be a concrete mixer of 7 cubic feet capacity, so arranged that it can be either loaded or discharged at the side or the end; and a model of a bituminous macadam plant. The latter has been borrowed from the South Kensington Science Museum, and is complete in every detail from the feeding elevator to the tar pump and the measuring tank.

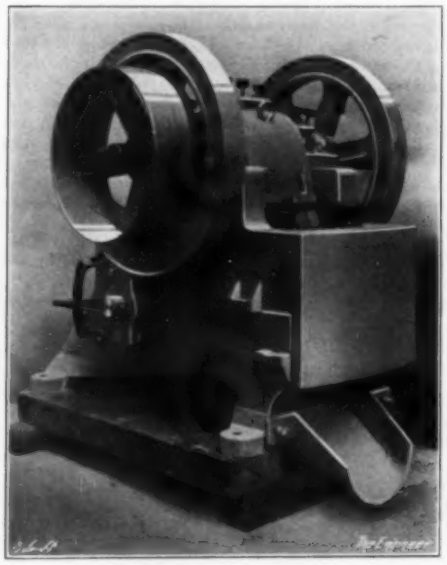


FIG. 55—STONE BREAKER—GOODWIN AND BARSBY

ROBEY AND CO., LTD.

On the stand of Robey and Co., Ltd., of Lincoln, there will be shown in operation an example of the new design of horizontal cold-starting oil engine which was recently placed on the market by the firm. The engine exhibited is illustrated in Fig. 56, and consists of a 28 B.H.P. model with a cylinder bore of 9$\frac{1}{2}$in. and a stroke of 17in., running at a designed speed of 270 r.p.m. It is one of the smaller sizes in a range of six engines, varying from 20 to 100 B.H.P., some of which are, however, of the twin-cylinder form, and are designed to give double the outputs.

Although previous mention of the engine has been made in THE ENGINEER, we may recall on this occasion some of the principal features of the design. Fig. 57 shows a section through the cylinder head and serves to illustrate the valve gear. It will be seen that an excentric is employed to work the upper air valve and the lower exhaust valve, the motion being transmitted to the valves through arrangements of compound levers, which, it is claimed, relieve the lay shaft of any sudden or heavy stresses. For purposes of illustration the covers to the valves in Fig. 57 are indicated as broken off, but reference to Fig. 56 will show that the heads of the valves, along with the lever mechanism, are totally enclosed in dust-proof casings. Another feature of the valve design is the provision in the air valve cage of a relief valve, which consists of an arrangement whereby the air valve casing itself is made to lift slightly against spring load in case of excess pressure in the cylinder space.

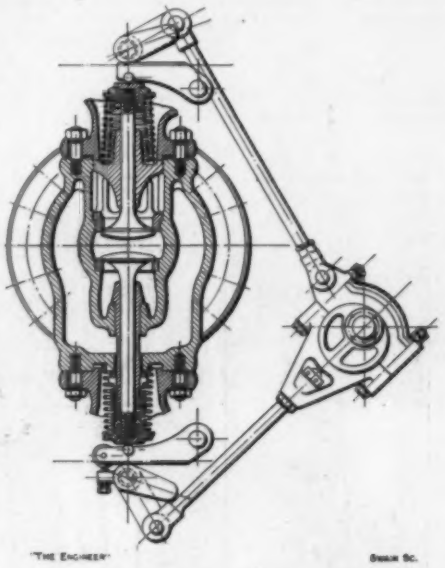


FIG. 57—CYLINDER HEAD—ROBEY

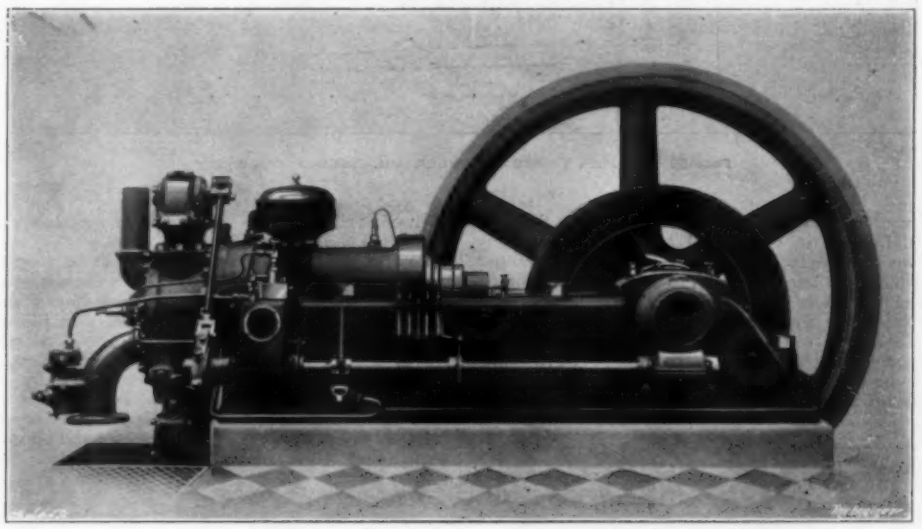


FIG. 56—28 H.P. COLD-STARTING OIL ENGINE—ROBEY

The large area of the valve casing provides for instant relief of any excess pressure and gives security, so the makers claim, from possible damage due to such pressure.

The cylinder head casting in which the valves are housed is formed in such a way that there are no connecting ribs to tie the outer wall of the water jacket to the heated part of the casting in contact with the combustion space. Initial casting stresses are thus avoided, as well as heat stresses in working. A convenient feature of the arrangement is the provision of a steel expansion plate, which covers the whole of the water space, and, while allowing for expansion and contraction, gives easy access on its removal to the water spaces in the cylinder head.

The cylinder head is so designed that it can be removed without having to dismantle any part of the lay shaft, and it is evident that care has been bestowed on the accessibility of all running parts by providing suitably designed inspection covers.

Particular interest attaches to the construction of the atomiser and the fuel pump and the means employed for varying the time of fuel injection to meet varying qualities of different oils.

A simple type of sprayer of patented construction is employed which permits a regulation of the spring pressure on the needle valve, and the use of varying lifts to meet the special requirements of different grades of fuel. In Fig. 58 we show a section through the fuel pump and the control mechanism, which is operated by the centrifugal governor. Dealing first with the fuel pump itself, it may be noted that a hardened steel plunger is used, which is ground and lapped, and works in its barrel without the need of packing. Both the suction and delivery valves are of the ball pattern, and double bank valves are provided. A small blow-off valve is fitted at one side of the pump to relieve any excess pressure. Over the end of the plunger barrel there is fixed a circular loose sliding shoe, on the inner surface of which the bottom of the plunger rests. Motion from the quick-opening fuel cam on the lay shaft is transmitted to the plunger shoe, through a pivoted arm carrying the fuel cam roller and an intermediate guided roller, the position of which is varied by the governor. From the drawing we reproduce it will be seen that the leverage of the fuel cam roller arm is greatest when the roller controlled by the governor is in the outer position, as shown, so that as it travels inwards the stroke of the fuel pump plunger is gradually reduced.

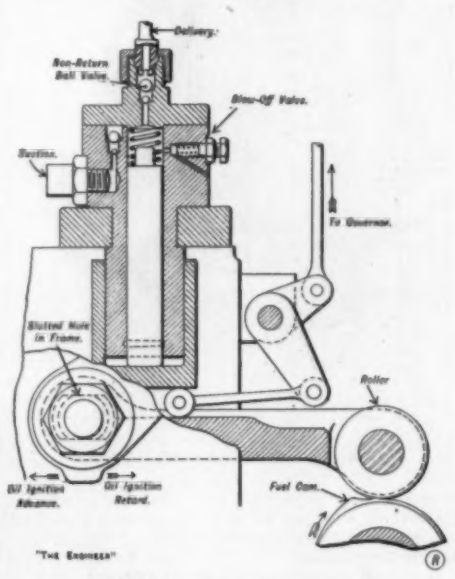


FIG. 58—FUEL PUMP—ROBEY

The fulcrum pin which supports the fuel cam roller arm, on the machined surface of which the governor

roller slides, is secured by a lock-nut in a slotted hole in the bed-plate frame. By slacking off the nut the roller arm can be advanced or retarded, thereby giving earlier or later fuel ignition. The design of the locking device is so arranged that this adjustment can be made while the engine is running.

Crossley Bros., Ltd.

The exhibit of Crossley Bros., Ltd., will include examples of oil engines built at each of the four factories of the company, and there will be four engines

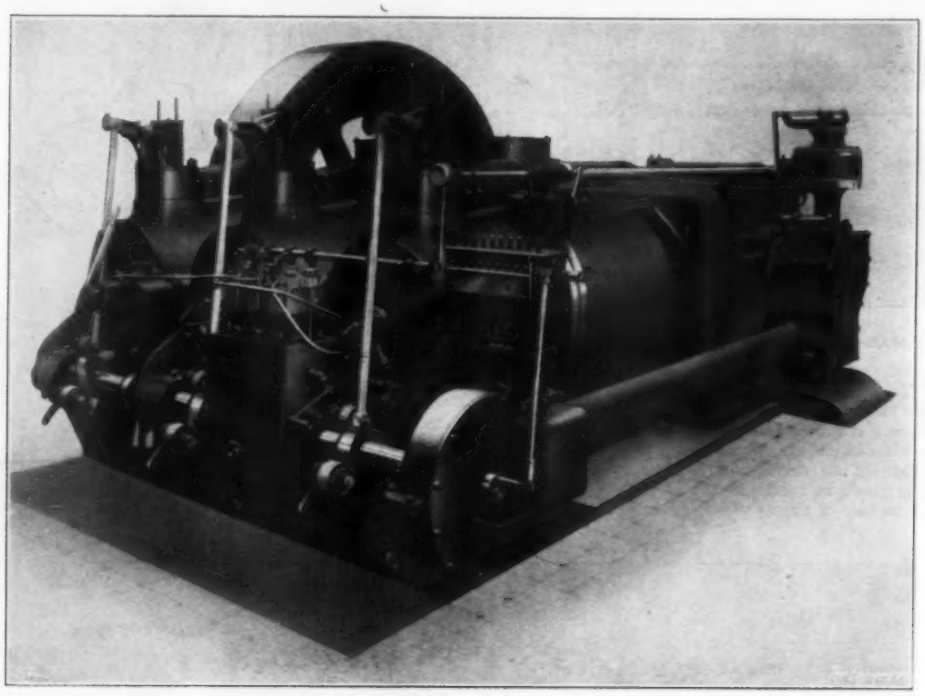


Fig. 59—150 H.P. Three-Cylinder Oil Engine—Crossley

of varying outputs from 150 B.H.P. down to 3 B.H.P., all of which will be running. In Fig. 59 we show a typical example of the firm's practice, which is a three-cylinder horizontal engine of the Crossley-Premier four-stroke cycle type, built at the works of the Premier Gas Engine Company, Ltd., at Sandiacre, near Nottingham. It has a designed output of 150 B.H.P. at a normal speed of 275 r.p.m., and the cylinders each have a bore of 12in. with a stroke of 20in. The bed-plate is of the box type and

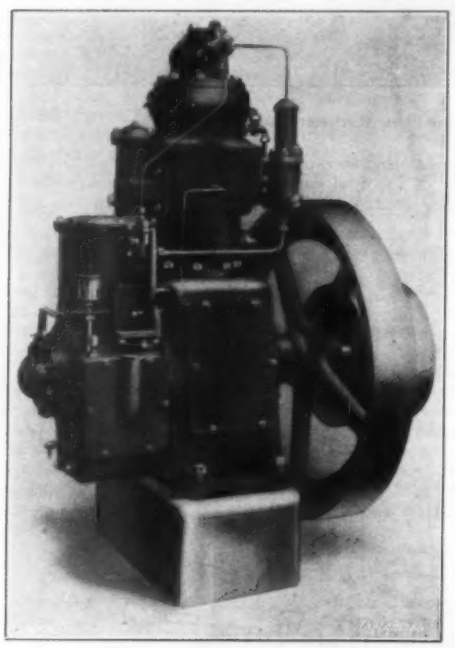


Fig. 60—10 H.P. Oil Engine—Crossley

hinged crank case guards are fitted which are easily thrown back, so as to give complete access to the connecting-rods and pistons for purposes of inspection. As our illustration shows, the water jacket casting is bolted to the bed-plate by a broad flange. The breech end of the cylinder and the liner are cast in one piece, and the usual gas-tight joint between them is thereby done away with. A circular plate forms the back end of the cylinder, which, when removed, gives full access to all the water spaces in the cylinder head. The air inlet and exhaust valves, unlike those shown in our illustration, are slightly angled toward one another, and they are operated by rods and levers from the cross lay shaft, which is gear-driven from the side shaft. Air is entrained through louvred boxes on the top of the engine, and passes round the cylinder jacket spaces and through air trunkways on the top of the cylinders to the inlet valves.

The water-cooled exhaust valve casings are fitted with large sized inspection doors. The inlet and exhaust valves are each furnished with two springs, and by means of an ingenious yet simple attachment either of these springs can be removed or replaced while the engine is running.

To the right of our illustration will be seen the governor and side tension rod, with its adjustable speeder spring. This rod works an oscillating shaft running above the fuel pumps parallel with the cam shaft. The amount of fuel oil delivered to the cylinders is determined by cam-operated by-pass valves on the separate fuel pumps, controlled by the governor through wedge blocks, which are interposed between the driving pieces and the stems of the by-pass valves. The fuel pump is fitted with a hand pumping device and hand controlled by-pass valves. Air-less fuel injection is employed, and the spray valves are arranged at the centre of the cylinders. A mechanically operated lubricator supplies oil to the pistons, liners, the small ends of the connecting-rods, and also to the stems of the exhaust valves. The main bearings and big ends are supplied with oil under pressure by a valveless pump driven from the side shaft. Duplicate filters are fitted in the oil circuit, so that the oil from the crank chamber is strained before it is again circulated through the system. The engine is started by compressed air, which is stored in a receiver at 250 lb. per square inch. The air starting valve gear will be seen to the left of Fig. 59. With the type of engine described a fuel consumption of round about 0·40 lb. of oil per B.H.P. hour over a wide variation of load is obtained. The engine is built on the standardised unit principle, and engines are supplied in two, three, four, six and eight-cylinder sets covering a range of powers from 100 to 1000 B.H.P.

Another Crossley heavy oil engine to be shown running is a single-cylinder horizontal open type, also working on the four-stroke cycle principle. We do not illustrate this model, but it has a designed output of 48 B.H.P. at 270 r.p.m. and a cylinder bore of 11in., with a stroke of 20in. It is typical of a range of single-cylinder engines from 22 to 140 B.H.P., which, as double-cylinder units, give powers up to 280 B.H.P. These engines are started from cold or by compressed air, and work on the airless fuel injection principle; the fuel consumption of this model is about 0·42 lb. per B.H.P. hour.

Fig. 60 illustrates a two-stroke cycle type of vertical engine which is built by Crossley Bros., Ltd., in four different sizes, ranging from 6 to 20 B.H.P.

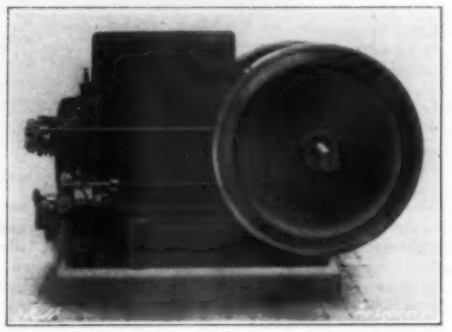


Fig. 62—Oil Engine—Crossley

That to be shown has a designed output of 10 B.H.P., which it develops at a normal running speed of 550 r.p.m. The cylinder has a bore of 5½in. with a stroke of 7in., and the fuel consumption is 0·55 lb. of oil per B.H.P. hour at full load. The general arrangement of the engine and its separate air scavenging pump are shown in the accompanying engraving. The scavenge pump is accommodated in a separate casing, bolted on to the main engine casing, and is driven by a separate crank. The air is drawn through a filter into the scavenge chamber, which it enters through a link operated piston valve in the head of the scavenge piston. A scavenge pressure of 1 lb. to 2 lb. per square inch is employed, the air being admitted to the main cylinder by a piston valve. A simple type of spray valve is fitted, and a lubricating oil pump serves all bearings. This type of engine, which is totally enclosed, is supplied both for industrial and electric lighting service.

The smallest engine displayed on the stand will be a 3 B.H.P. Crossley hopper-cooled petrol paraffin unit, a section through which is reproduced in Fig. 61. It has been designed principally for farm use and for

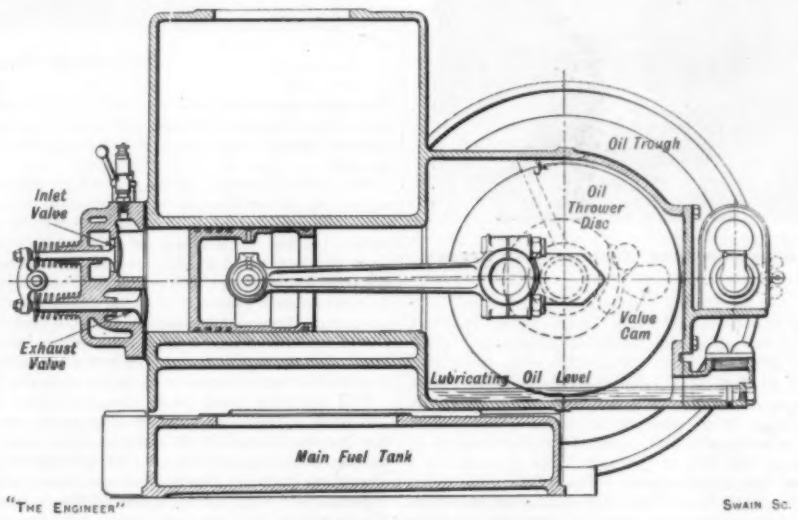


Fig. 61—3 H.P. Oil Engine—Crossley

the driving of small electric lighting plants. The engine to be exhibited on the stand is the second of three progressive sizes of units which are designed for outputs of 2, 3 and 6 horse-power, at moderate speeds of 650 to 550 r.p.m. The section Fig. 61 shows the main features of construction. The liner, bed-plate, water-cooling hopper and crank case are made in a single casting, to which the cylinder head with the air inlet and exhaust valve is bolted. A single rocker arm serves to operate both valves and it receives its motion through a bell-crank, which in turn is moved by a push rod and cam roller engaging with a cam on the crank shaft. In the drawing the cam is indicated by dotted lines. On the top of the cylinder there is the ignition plug and a petrol cup to facilitate

starting the engine, which is intended to start on petrol and to run on paraffin fuel. A centrifugal type of governor which operates a butterfly valve in the carburetter system is fitted.

With a view to allowing the engine to run unattended over long periods a special lubricating system is employed. There is an oil throwing disc mounted on the crank shaft, which dips into the oil bath, and, picking up the oil, transfers it to a distributing trough at the top of the crank case, from which it flows to the various bearings and reciprocating parts.

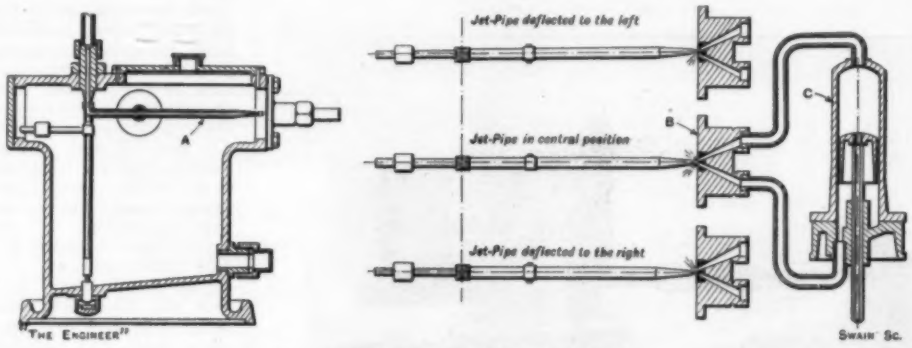


FIG. 63—REGULATING DEVICE—REAVELL

REAVELL AND CO., LTD.

The Reavell-Askania regulator, to be exhibited by Reavell and Co., Ltd., of Ipswich, is claimed to respond to the smallest disturbance, to give a speed of regulation which is proportional to the magnitude of the disturbance and to have practically no frictional resistance or inertia in its moving parts. The apparatus is applicable to the regulation of gas, water, steam and other supplies with the object of keeping their pressure, volume or temperature constant, or, in the case of two or more fluids, of keeping the ratio of the supplies constant. It can also be applied to effect the control of machinery, as, for example, to govern the speed of a mechanical stoker in accordance with the demand on the boiler.

The device, as shown in Fig. 63, makes use of a jet pipe A comprising a nozzle arranged to swing horizontally about a hollow perpendicular pivot through which it is supplied with oil under considerable pressure. Facing the end of the jet pipe is a distributor B, in which there are two small orifices. These orifices open into passages from which pipe connections are taken to the ends of a cylinder C containing a piston. If the jet pipe is central, the oil from its nozzle strikes equally on both orifices. Its kinetic energy is almost completely converted into static pressure, which is equal on both orifices and on both sides of the piston in the control cylinder C. That piston therefore remains at rest. If the jet pipe moves to one side or the other, the pressure on one of the orifices is increased, and that on the other is diminished. This pressure difference, acting on the piston, causes it to move in the one direction or the other. It will be appreciated that a very small movement of the jet pipe can be made to produce an adjusting force and a movement of the piston of any desired magnitude.

The movement of the jet pipe is produced by the disturbance, which the apparatus is applied to control. In Fig. 64 we illustrate the system applied to the control of the pressure in a gas or air main D. A leather diaphragm E, open on one side to the pressure in the main, is connected by a push rod to one side of the jet pipe. The opposite side of that pipe is acted upon by the pressure of a spring. If the pressure in the main rises the jet pipe is moved over towards the left, and as a consequence the difference of pressure in the cylinder C causes the piston to move to the left, and partially close the butterfly valve F. When the pressure on the right of the butterfly valve falls to the original value, the pipe A returns to the central position under the action of the spring, and produces equal pressures on the two sides of the control piston.

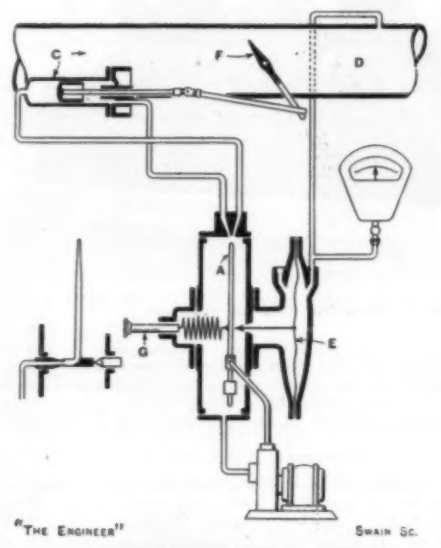


FIG. 64—GAS REGULATOR—REAVELL

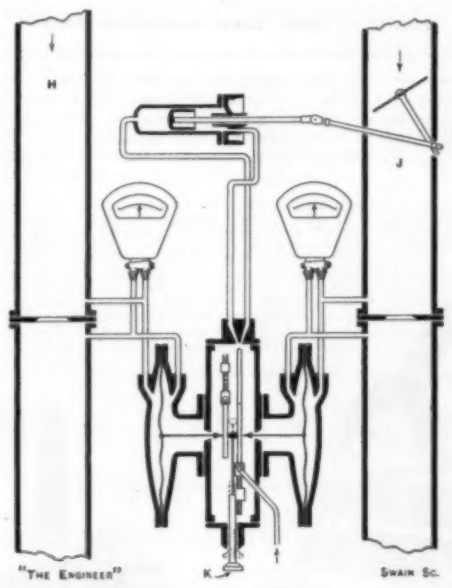


FIG. 65—GAS MIXTURE REGULATOR—REAVELL

The piston therefore remains in the position to which it has been displaced, and the butterfly valve continues in the partially closed position. A reverse action takes place should the pressure in the main fall. The pressure to be maintained is determined by adjusting the spring by means of the plunger G.

The apparatus can be used for regulating suctions or vacua by taking a connection from the main to the left-hand branch on the diaphragm casing. If the object is to maintain a constant mixture of two gases—one of which may be air—the gases are caused to flow in two separate pipes, each of which, as shown in Fig. 65, is provided with a baffle, and one of which contains a butterfly valve. The differential pressures set up by the baffles are measures of the gas quantities passing through the mains. The jet pipe is acted upon by two push rods, each of which is connected to a leather diaphragm. The opposite faces of each diaphragm are connected to the opposite sides of the baffle in the adjoining main. Should the flow of gas in the main H fall, the differential pressure at its baffle will become less, and as a consequence the jet pipe will be pushed over to the left. This movement will, in turn, lead to the partial closing of the butterfly valve in the main J. Equilibrium will be restored when the flow in the main J has fallen to the extent required to recover the original ratio prevailing between the two flows. That ratio can be set by means of the plunger K movement of which alters the point, at which the force of the left-hand push rod is transmitted to the jet pipe. It may be noted that there is a certain difference in the action of the apparatus illustrated in Fig. 65, according as the disturbance is a change in the flow in the main H or a change in the flow in the main J. In the first case the ratio of the flows is maintained by reducing the flow in the main J to suit the reduced flow in the main H. In the second case, the reduced flow in the main J has the effect of opening the butterfly valve until the flow in J is restored to its former value relatively to the flow in the main H. In both cases the ratio of the flows is maintained constant, but in one the volume of the combined flows is affected, while in the other it remains constant. In many practical applications, the distinction indicated is a desirable feature. If, for instance, the apparatus is applied to maintaining constant the mixture supplied to a gas engine, the gas would be passed through the main H and would be under the separate control of the engine governor in the usual way. The air in the main J would be regulated to suit the variation in the gas flow by the action of the diaphragms and jet pipe.

If unusually high operating forces or speeds are required, an auxiliary distributing valve is used in conjunction with the regulator. In this case, the jet pipe does not deliver oil directly into the control cylinder, but governs the movement of the distributing valve, which is mounted on the regulator, and which controls the supply of oil to the cylinder. The pressure and the amount of oil delivered into the control cylinder can therefore be as high as desired without affecting in any way the accuracy or sensitiveness of the regulation.

RUSTON AND HORNSBY, LTD.

The engines which will be displayed on the stand of Ruston and Hornsby, Ltd., of Lincoln, are representative of both the horizontal and the vertical types of cold-starting oil engines, built by the firm. In Fig. 69 we show the 20 B.H.P. 310 r.p.m. horizontal type of engine, which is the second smallest size in a range of thirteen single-cylinder and nine double-cylinder engines, which are built by the company, and embrace outputs from 16 up to 340 B.H.P. The engraving serves to show the general design of the cylinder head and valve gear, the arrangement of the governor, the fuel pump and the mechanically operated lubricator. The engine works on the four-stroke cycle, and the degree of compression is sufficient to ignite the atomised oil without having recourse to lamps or electric starting appliances. The range of oil fuels which these engines can use includes refined, residual, tar and vegetable oils.

In Fig. 69 we show a three-cylinder vertical engine, which is to be shown and which has a designed output of 57 B.H.P. at a normal speed of 450 r.p.m. The crank case is mounted on a deep bed-plate and carries within it the gear-driven cam shaft, which operates push rods for the inlet and exhaust valve levers. The spray valve is arranged at the top of the cylinder, but the inlet and exhaust valves are both of the horizontal type. A gear-driven cooling water pump supplies the cylinder jacket and cylinder head spaces. At the end of the bed-plate there are the governor fuel pump and the lubricating oil pump. A feature of the Ruston multi-cylinder engine is the single fuel pump and the patented fuel distributor gear, a typical section through which is reproduced in Fig. 66. As the drawing shows, the gear consists essentially of a reciprocating plunger with passages through it by which the fuel oil is directed to the atomisers in correct sequence. By means of a double arrangement of cams the plunger is moved positively in both directions. Any leakage of fuel is returned to the fuel tank by the pumping action of the underside of the plunger. This leakage is found in practice to be very small and not such as appreciably affects the quantity of oil delivered by the plunger. In any case a small amount of leakage oil acts as a lubricant to the working parts. This device, we understand, has effectually solved the problem of ensuring an equal distribution of fuel to all the cylinders of an engine and it also obviates any danger of one cylinder carrying more than its normally apportioned share of the engine load. Vertical engines of a type similar to that we have described are built by the firm in a series of six groups, with cylinders from one up to six and with outputs from 38 up to 1000 B.H.P. In the larger sizes of engine

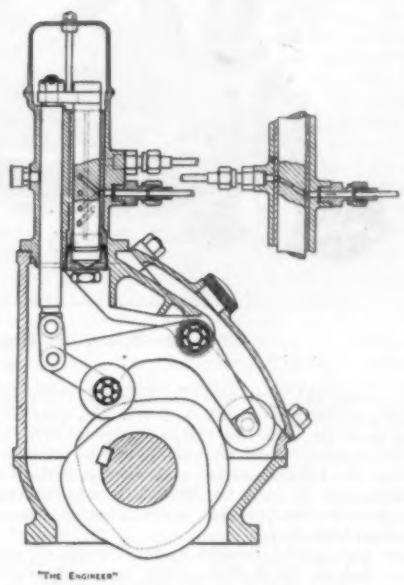


FIG. 66—FUEL PUMP—RUSTON

the valves are not worked by push rods and cam gear, but are operated by oblique rods and levers, which are worked from an oscillating shaft.

A small exhibit which will be shown in operation on the firm's stand comprises a two-stage Ruston air compressor, driven by an alternating-current motor. This unit is used for charging air receivers for engine starting, and a self-lubricating water-jacketed compressor is employed which will work at pressures up to 300 lb. per square inch.

A noteworthy exhibit on the Ruston and Hornsby stand will be a petrol-paraffin engine-driven universal excavator. This model is a specially small excavator of the full circle revolving type, which, with suitable attachments, can be employed as a half cubic yard bucket excavator, a crane navvy, a dragline excavator, a grab excavator, a skimmer scoop, a trenching machine, or an ordinary locomotive crane. Our illustration—see Fig. 67—shows the machine arranged as a back-acting trencher.

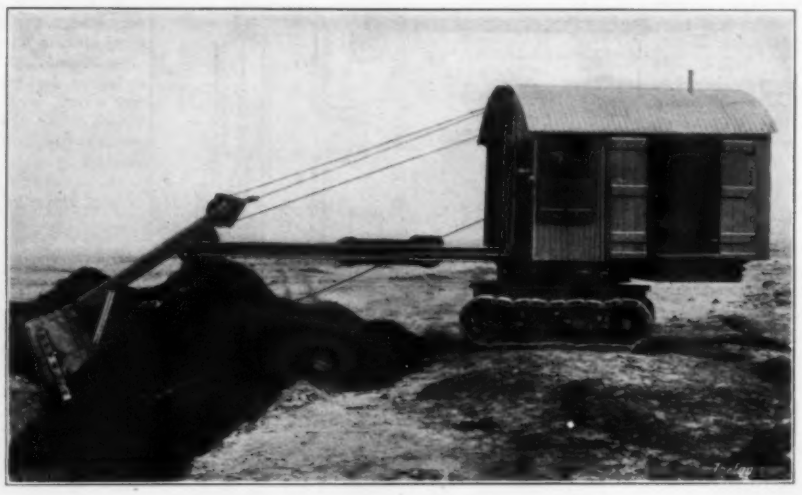


Fig. 67—½ Cubic Yard Excavator—Ruston

It will be seen that it is mounted on caterpillar tracks, which are so arranged that they can be moved independently of each other, thereby giving to the machine good steering and manœuvring qualities. The tracks are of large width, and a useful feature is the totally enclosed travelling gear, which prevents the mechanism from becoming fouled when operating in bad ground. The complete equipment weighs only some 14½ tons, and the design is such that the machine can pass through a 7ft. 6in. gateway and can walk on to a low railway wagon. The overall dimensions are such that the machine, on rail, easily passes the loading gauge, and when it arrives at the destination it can be unloaded and started up under its own power without any dismantling taking place.

In the petrol-paraffin engined type of machine exhibited a 32 B.H.P. 1000 r.p.m. four-cylinder Dorman engine is employed, which gives a good margin of power for peak loads. When required for steam operation, a self-contained piston valve engine, with two 90 deg. cylinders, each having a stroke of 4in. and a bore of 5in., is installed, the steam being raised in a multitubular smoke-tube boiler. The unit can equally well be fitted with a 28 B.H.P. electric motor and controller for electric operation, and in this case the motor runs continuously. The various motions, such as travelling, hoisting, slewing and derricking, are then controlled by clutches similar to those which are employed on steam and petrol-paraffin driven machines. In the latter type of machine sufficient fuel is carried for twenty-four to thirty hours' service. The engine is provided with a large radiator and cooling fan, and a feature of the design is the convenient position of the controls at the forward left-hand side of the revolving platform, which position gives to the driver an uninterrupted view of all the various operations he has to carry out. The controlling levers are so grouped that the operator can reach and work them all while remaining seated on the machine.

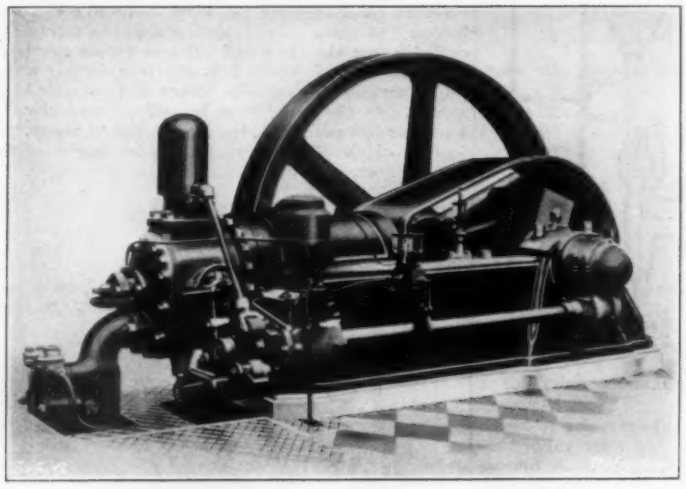


Fig. 68—20 H.P. Oil Engine—Ruston

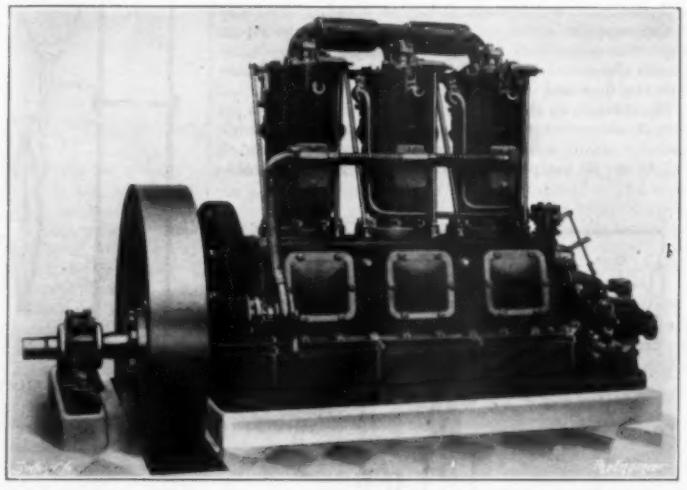


Fig. 69—37 H.P. Oil Engine—Ruston

Guest, Keen and Nettlefolds, Ltd.

The main feature of the display of Guest, Keen and Nettlefolds, Ltd., Birmingham, will be a cinematograph film, which will be shown within a more or less closed stand. This film demonstrates the blasting of the iron ore, the mining of the coal for the production of the necessary coke supplies, the quarrying of the limestone, the blast-furnace processes for the making of pig iron, steel-making and so on through the billet and rod rolling and wire-drawing operations to the final stages of the manufacture of Nettlefold's screws, &c. Outside the stand there will be a number of showcases containing specimens of iron and brass wood screws; black, bright and brass bolts and nuts of all descriptions; metal thread screws; coach screws; carriage and tire bolts and nuts; bright bar and special pattern work; rivets and washers; galvanised roofing screws, &c.; screw hooks, screw eyes and rings, &c.; gate hooks and eyes; cotter and taper pins; tram and clout nails; copper rivets, nails and washers.

Earle, Bourne and Co., Ltd.

Earle, Bourne and Co., Ltd., of Birmingham, intend to exhibit a collection of cold-rolled brass of various alloys and copper; solid-drawn brass and copper tubes for locomotives; condensers, sugar refineries, engineering, plumbing, &c.; brazed brass and copper tubes, plain, ornamental, round, square, oval, flat, twisted, reeded, &c.; polished and lacquered cased tubes for bedsteads, shop fittings, &c.; angles, channels and sections; shop front mouldings in brass, copper, bronze, nickel silver, &c.; handrails in brass, copper and bronze; mouldings and tubes for fenders and hearth furniture; nickel silver sheet, strip and tube; bends in square brass, round cased tube and nickel silver; copper bends for sanitary, plumbing and heating trades; light copper tubes for domestic water service.

Paints and Varnishes.

The group of companies including Nobel Chemical Finishes, Ltd., Naylor Brothers (London), Ltd., and the Frederick Crane Chemical Company, Limited, will show their products in close proximity one with another. These products will include all kinds of paints, varnishes, cellulose finishes and wall papers, besides Crawshaw's chemical colander, on a separate stand. This machine is a development on the chemical side of the business, which enables engineers and others to remove grease from metal parts in an efficient and economical manner with the aid of a chemical.

Marshall, Sons and Co. Ltd.

Marshall, Sons and Co., Ltd., of Gainsborough, will exhibit a group of heavy oil engines, including a 60 B.H.P. vertical engine of their new "M V" series. It closely follows the firm's standard practice for oil engines, being of the two-stroke cycle type. Instead, however, of having the hot bulb arrangement, starting is effected by a glowing plug in conjunction with an electric battery and a charging dynamo. By these means the engine can be set to work as speedily as a "cold start" type, and thus, in practice, is a simpler engine, involving lower working pressures and stresses, and less wear and tear is the result. The other engine on view is to be a 16 B.H.P. horizontal fixed type.

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THE ENGINEER.

FEBRUARY 17, 1928.

Steam Research in America.

THERMODYNAMICS can be regarded as an exact science in so far as results can be deduced with certainty when once the properties of a working substance have been postulated. Its principles are usually illustrated by reference to an imaginary, but most convenient substance called a "perfect gas," which has no molecules to form an incompressible residue, to affect its volume by temporary coalescence, or to vary its specific heat by being set into vibration. Steam, the thermal medium with which engineers are mainly concerned, suffers from all these complications and from the consequences which they entail. Regnault, the great French physicist, by means of his wonderful experimental work, put our knowledge of its properties upon a basis which sufficed for two or three generations, but the use of higher temperatures and pressures, and, above all, the need for an exactitude warranted by the overwhelming importance which steam has acquired as a means of power production has brought many later investigators into the field. Some have made experiments upon particular properties, and others have endeavoured to co-ordinate the various experimental results into the form of steam tables of direct use to engineers. Unfortunately, not only have the experiments been inconsistent, but sometimes, even, the steam tables give contradictory values if some property of steam is obtained in two different ways from the same data.

The first man to reduce matters to comparative order was Professor Callendar in this country. He propounded a set of equations from which self-consistent tables could be computed, and for his insight and experimental skill deserves to be ranked with Regnault as one of the founders of exact knowledge of the properties of steam. Callendar's tables are recognised as the standard in this country, and are almost certainly the most correct available over the range of temperatures and pressures in ordinary use. The equation, however, which forms the basis of his tabulation, although extremely simple and convenient for calculation, is open to theoretical objections when applied to very high pressures. It is known, for example, that if the product of pressure by volume be plotted against pressure for any gas, the temperature remaining constant, the line so obtained, instead of being straight and horizontal as Boyle's law would require, slopes downwards to a minimum and then up again. The physical explanation of this fact would appear to be that the initial downward slope is due to the increase of "coalesced" molecules as the pressure rises; while the subsequent upward slope is caused by this effect being overwhelmed by the growing importance, as the density of the gas becomes greater, of the incompressibility of the molecules themselves. The isothermal line for the critical temperature should indeed slope downwards with increasing steepness until the critical pressure is reached, at which point it would become vertical. For pressures well below the critical, it is probably quite sufficiently accurate to take, as Callendar does, the coalescence factor as a function of the temperature only. The result of this assumption is to make the Callendar isothermals for this region all straight lines, sloping downwards at an angle which is greater the lower the temperature. It is clear, therefore, that while the Callendar equations may give all the accuracy desired at pressures up to say, 500 lb. per square inch, at pressures much in excess of that figure the tables computed from them may fail appreciably to represent the actual properties of the steam. Whether the discrepancy will be greater than the inevitable errors of experiment, and, if so, beyond what values the calculated values need correction, are questions which still await answers.

The work now going on, both in this country and abroad, indicates that the answers should not be long delayed. In the United States, particularly, the experimental determination of the properties of steam is being pursued with great energy, the laboratories of the Bureau of Standards, of the Harvard University, of the Massachusetts Institute of Technology, and of the General Electric Company being all actively engaged on investigations directly connected with the problem. The work is being co-ordinated by a committee of the American Society of Mechanical Engineers, under the able chairmanship of Mr. George Orrok. From time to time the progress made is recorded in the columns of *Mechanical Engineering*, the well-known organ of the Society, and reports covering the developments of the past year are to be found in the current issue, namely, that for February, 1928. These should be studied *in extenso* by all who are interested, either as engineers or as physicists, in the properties of steam. It will be remembered that in *Mechanical Engineering* of February, 1926, a very elaborate table giving the specific volumes of saturated and superheated steam from 1 lb. to 1200 lb. pressure and temperatures up to about 800 deg. Fah., was published by Mr. J. H. Keenan, of the General Electric Company. The same author reports that this table, which was founded on experiments extending to no more than 160 lb. per square inch, has now been checked with direct experiments made by Dr. L. B. Smith, of the Massachusetts Institute of Technology, at pressures ranging from 1325 lb. to 3827 lb. per square inch, and temperatures ranging from 590 deg. to 752 deg. Fah. The agreement has been found so good as to justify, in Mr. Keenan's opinion, the A.S.M.E. table for pressures below 1000 lb. per square inch, and to warrant the acceptance of the new volume determinations as a basis for calculating a new steam chart for pressures above 1000 lb. per square inch. It is to be noted that the figures for specific volume accepted by these American investigators are appreciably lower than those of the Callendar tables. They are indeed the lowest to be found in all the tables, with the exception of those of Knoblauch, while Callendar's are the highest, if we disregard the Marks and Davis tables, which are known to be unsatisfactory. As an example of the discrepancies, the specific volume of steam at 1000 lb. pressure and 750 deg. Fah., is given by Callendar as 0·677, by Mollier as 0·662, by Goodenough as 0·659, by Stodola as 0·654, by Knoblauch as 0·625, and by the A.S.M.E. tables as 0·648 cubic feet per lb. When isothermal lines of the nature to which we have referred above, are plotted on a diagram of which the ordinates are P V/T and P, the A.S.M.E. values slope downwards in easy curves, nearly straight in the region of low pressures, but descending with considerably greater steepness than the lines of Callendar. As far as

one can judge from the A.S.M.E. diagram by eye, the critical temperature isothermal would be substantially vertical at the critical pressure, and thus the theoretical requirements in this respect would appear to be more or less perfectly fulfilled. This fact, taken in conjunction with the closeness of agreement between the original A.S.M.E. table and the experiments of Dr. Smith, would seem to justify confidence in the table.

Another report, dealing with the progress of steam research at the Bureau of Standards, is of particular interest as it recommends a new value for Joules' equivalent of heat. The value taken as official in England, and adopted by the recent Heat Engine Trials Committee, is 777·78 foot-pounds at mean sea level at Greenwich. This is defined as the mechanical work equivalent, to the $^1/_{180}$th part, of the heat required to raise the temperature of 1 lb. of water from 32 deg. to 212 deg. Fah. The value proposed by the Bureau of Standards is 778·6 foot-pounds, a matter of somewhat more than one-tenth of 1 per cent. greater than the former. Expressed in absolute C.G.S. units, so as to avoid questions of sea level and latitude, the proposed new value of the mean gramme calorie is 4·1876 international Joules, as compared with the value of 4·18698 Joules accepted by the Heat Engine Trials Committee, and 4·1868 Joules adopted by Callendar. Both Callendar and the Bureau of Standards agree in defining the mean gramme calorie on the basis of the water being heated from 0 deg. to 100 deg. Cent., always under the pressure of its saturated vapour, a definition which results in a value for the calorie about 0·023 per cent. greater than if the water had been heated at constant atmospheric pressure. The Bureau of Standards believes its new equivalent of heat to be accurate within one part in 5000. Since, however, the figure of 778 foot-pounds, commonly taken as the equivalent of 1 B.Th.U., is well within the limits of accuracy of any ordinary engineering calculation, the question whether 778·6 is really more correct than 777·78 concerns physicists more than engineers. What is important is that this and other physical data should be subjects of international agreement. It is quite bad enough to have a different ton and a different gallon from those used in the United States, but these, after all, are matters of definition only. The name "ton" may as well, or possibly better, be given to a mass of 2000 lb. as to one of 2240 lb. But no such latitude is possible with regard to the volume of a pound of steam at a given pressure and temperature. This volume is, and must be, absolutely the same in America, England, Germany or Kamschatka. And similarly with every property of steam. Since these properties are all arrived at directly or indirectly from experiments, the difficulties of which increase enormously with the precision that is desired, agreement to the last decimal between the results obtained by different investigators is hardly to be expected. Nevertheless, some value has to be taken as the most correct by every man who makes computations about steam, and general agreement upon this value is essential if the performances of machines in one country are to be comparable with those obtained in another. It is, therefore, to be hoped that before long an international committee, composed of men whose names are sufficient guarantee that they place scientific accuracy before any question of personal or national prejudice, will take the matter in hand and recommend for adoption in all countries a unique set of steam tables.

Tank Engines on Express Trains.

THE reports by Colonel Sir John Pringle and Lieut-Colonel Mount on the derailments of tank engines at Sevenoaks and Bearsted in August last leave no reasonable doubt as to the cause of those mishaps. It is unnecessary to say more than has already been said about them. But in connection with Sir John's investigation into the Sevenoaks accident, a series of experiments of a rare kind were carried out by Mr. H. N. Gresley and Mr. J. L. M. Moore. We deem it desirable for the benefit of those of our readers who have not ready access to the reports to give some account of those trials. Hence we reprint on other pages several tables and a portion of the text which form the appendices to the Sevenoaks report. We do this with the greater pleasure, because, having held consistently that there is nothing inherent in the design of tank engines which makes them unsuitable for express work, we are gratified to find that the critics of the design have now been answered clearly and definitely by positive running tests.

We may particularly direct attention to the first of Mr. Gresley's tables—No. IV. in our article—which deals with the runs made on October 16th on the London and North-Eastern Railway. It will be seen that the engines were run backwards and forwards over the road between St. Neots and Huntingdon. They were not turned, and ran, therefore, alternately with the pony truck and the bogie leading. It must be observed, too, that the conditions of the tanks varied between full and nearly empty. Thus we have a set of tests which, except for the absence of a complete train, represent as nearly as possible the actual conditions of service. Now if the two last columns be examined, it will be seen that even at speeds up to as much as 83½ miles per hour the engines ran as well as could be desired, and there was never anything approaching a dangerous roll. There is, however, one point of exceptional interest. It is that the down runs were, if anything, better than the up runs. Looking at the plan of the road which we reprint, it will be seen that there is nothing in it to account for the difference, and Mr. Gresley's note that "when running backwards, bunker first, with the bogies leading, the riding of both tank engines was distinctly steadier than when running forwards with the pony truck leading," can therefore only mean that he found the pony less steady than the bogie. That does not mean that the former is unsuitable for its work. The difference was evidently not pronounced, and Mr. Gresley's final opinion that "both the tank engines are well-designed, efficient engines, and on a road well laid and well maintained, are suitable for working express trains," may be accepted without the slightest reserve. Mr. Moore, too, reports that "the steadiness of the tank engines was particularly noticeable throughout, and on no occasion was anything of a continuous roll set up." He, also, observed that the engines ran more steadily backwards than forwards, but he does not suggest that the two-wheeled truck showed any defect. All that might be said with regard to that interesting point is that on a good road either the pony or the bogie may lead with safety, but that the engine will be somewhat more comfortable if the bogie is in front. It must, however, not be forgotten that the conditions are changed somewhat when the engine is run bunker first, for the weight on the rails under the bogie wheels with the bunker tank full is 19 tons 3 cwt., and the load on the rails under the pony wheels is only 11 tons.

These trials have done more than anything else to re-establish the reputation of the tank engine for express work, which was for a time shaken by the two derailments on the Southern Railway. That is all to the good, for there can be no doubt about the convenience of tanks for not a few express services in this country. We believe the credit of first producing a tank engine for express trains is due to Mr. D. Earle Marsh, who, as far back as 1910, turned out two 4–6–2 engines for the London and Eastbourne and London and Brighton services which are working satisfactorily to this day. Mr. Billinton—Mr. Marsh's successor—followed his example, but built heavier engines of the 4–6–4 type which have, since 1915, hauled expresses regularly. A few years later Mr. Maunsell designed the "River" class for the then South-Eastern and Chatham Railway. Those engines, now twenty-one in number, have run well over one million miles, and the first of them, "No. 790," of 1917, about 317,000 miles. When the manifest advantages which the tank engine enjoys—its shortness, its reversibility, the absence of dead tender weight, the employment of more weight for useful adhesion, and so on—are considered, its complete vindication must be regarded with satisfaction.

Literature.

Britain's Fuel Problems. Published by the *Fuel Economist*, London, 1927. Price 42s. net.

THIS handsome volume is really a systematically arranged collection of papers by various authors on problems in connection with the preparation and utilisation of coal for various purposes. There is a Foreword by Sir Alfred Mond, summarising the subject in a somewhat pessimistic way, with emphasis on how much better things are done elsewhere than in Britain. One may agree with many of the arguments, amongst other things, that transported coal should be clean and bought according to its calorific value, that bigger coal trucks might be used, &c. &c. All these things may suit the large industries in which Sir Alfred Mond is interested, but it must not be forgotten that British industry as a whole is a complicated growth more than a century old, and that many seeming absurdities are the survival of the fittest. Sweeping, drastic reforms can be introduced wholesale in large chemical concerns, in some iron-smelting works, in electric generating stations, &c. &c., but to penetrate into the innumerable small works in the Midlands and round the great cities reform must be gradual and adapt itself to the economic resources of those concerned. In the aggregate, these small works form a considerable factor in the fraction representing the industrial part of the total fuel consumption of this country, and then mainly for the production of high temperatures, their power requirements being fairly inconsiderable. Cheap electric power will only partially help them, and they will no doubt prefer 14-ton trucks to those holding 90 or 100, which they cannot handle, and they are likely to burn rubbish as long as it means comparative economy. Let us hope that they will take to heart Sir Alfred's final words: "Fuel economy is a practical form of patriotism."

The introductory chapters of the book concern fuel economy in America, France, Germany and Belgium from the points of view of natives of these countries. Of them, the American and German articles are noteworthy, the former for statistics and figures elucidating improvements with time, and the latter for showing how fuel economy is practised in works. In spite of the vastly different conditions obtaining in the United States, the reforms actually introduced in steam practice are much the same as here, viz., higher boiler pressures, feed-water heating, superheat, &c., with similar figures. The use of powdered coal for boiler firing is extensively resorted to, in spite of complications involved. Low-temperature carbonisation is developing, blast-furnaces are worked more efficiently, and so on; but on the whole similar problems relating to industrial fuel economy remain unsolved there as here. No attempt is made to draw comparisons, which would lead to very little of a useful nature. The German article deals with generalities only, but its many suggestions make it highly interesting.

After these departures, the articles on British coal begin with an attempt at classification by Dr. L. Slater, who also gives useful information about the various British coal seams. The tabulated classification according to hydrogen content is hardly likely to appeal to chemists in general, as the total variations met with in practice are very small, when "dirt" has been allowed for in the ash, besides which the drying of the samples for analysis and determination of moisture is a very difficult thing indeed. Taken in conjunction with oxygen content and quantity and nature of the coke, as Schædler did years ago, the scheme becomes more useful. Dr. Slater's remarks about correct sampling being essential ought to be underlined, as the ridiculous farce of analysing a shovelful taken at random is rather the rule than the exception. Coals from the same seam vary surprisingly little, and the determination of moisture and ash in large samples by a periodical analysis is probably the best way with coals used up immediately; in cases of long storage, various other more difficult problems crop up. It seems a pity that this first article is so compressed that some of the most important information is given as references to literature in footnotes. Articles on various problems at the mines follow, to wit, one on the coal left behind in or at the pit at supports, parts of composite seams, &c., and another on power production and utilisation at the collieries, the latter showing how to find a use for the waste discussed in the former.

So far the getting of the coal; then follows the preparation of the coal for the market by dry and wet cleaning processes, and, finally, an article on briquetting brings the questions relating to coal as such to a close. There is not very much in bulk, but all the articles contain suggestions and information of use, to specialists even, and they should be ample for economists and others for whom this first condensed collection of data has evidently been compiled.

The utilisation of coal for power production and for metallurgical purposes forms the next part of the book. As a preamble, there is an article on the theory of combustion by R. Wiggington, who demonstrates how to find the optimum excess of air in producer gas production and boiler firing. With this article the book changes its nature and presupposes special knowledge in the reader. The first part of Mr. Wiggington's demonstrations introduces ultra-modern notions on flame combustion as a case of polyphase chemical equilibrium to explain that an excess of air is necessary for complete combustion and maximum effect. To get numerical results for various classes of fuel and modes of firing, he has, however, to fall back on Bailey's practical results in the end, amongst others. The optimum excess of air over and above the old "theoretical" amount is surprisingly large, and seemingly still larger excess is less harmful than a small amount of unburnt fuel. In other words, the most modern theory supports the old practical usage of keeping a good draught, moderately hot flue gases and using as much steam as the boiler will give off without losing pressure. A chapter on test firing in boilers for fixing design of fire arches and classifying coal relieves this theoretical departure. It is followed by one on the economical aspects of high pressures and temperatures, thus introducing the first of the "great" problems of

the future, which are all treated one after the other in separate articles of varying merit. Space will not allow us to review these separately, but the great importance of the subject may excuse a few further remarks. A printed symposium of this kind should contain a fairly exhaustive synoptic treatment of the organic connection between all the articles and on their joint bearing on, in this case, fuel economy as a factor in general political economy. Without something like that, it becomes a miniature "Encyclopedia Britannica," and not a book in the ordinary sense. Even with such an addition these generally excellent articles will have to be taken piecemeal by anybody, as there is a limit to the most enthusiastic reader's patience in changing from one writer's style to that of another in a seemingly never-ending progression. This book has no kind of synoptic chapter; it certainly has a fairly coherent plan, but the articles clash against one another even to one who has spent almost a lifetime in contact with the problems treated.

Anybody who expects, when reading the title, to find the particularly British fuel problems treated will be greatly disappointed, as 90 per cent. of the articles deal with universally felt needs for fuel economy. As a book of reference to the fuel specialist it is probably the most complete and versatile publication which has so far appeared. The task of the general editor has been stupendous, and he is to be congratulated on having brought together such a complete set of contributions of the highest standard. To men of science the book will certainly be welcome; but the reviewer fears that industrialists in general will find it above their usual standard of knowledge, though it is to be hoped that they will see fit to acquire it for their advisers. Some of the articles on furnace practice, utilisation of waste heat by steam accumulation, &c., and on heat insulation of plant are of such outstanding merit as to deserve being printed separately in a smaller, more handy volume.

Finally, one might say that maybe a new era of composite literature has arrived in science, though similar attempts in other directions have had scanty success, and the combined efforts of those responsible for this book deserve unstinted praise and recognition. But is there not still something in Wilhelm von Humboldt's dictum about his brother's famous "Kosmos"? He said: "You write without ending; it is not a book, it is a picture without a frame." For the sake of the good cause for which this book under review has been written, it is to be hoped that a good many will provide frames to their own liking.

Factory Organisation. By C. H. NORTHCOTT, M.A., Ph.D., O. SHELDON, B.A., J. W. WARDROPPER, B.Sc., B.Com., A.C.W.A., and L. URWICK, D.Sc. Edited by Professor J. H. JONES, M.A. London: Sir Isaac Pitman and Sons, Ltd. 1928. Price 7s. 6d. net.

IN reading books that deal with organisation it is often noticeable that the personal bias of the author is evident, with the result that if an accountant develops the theme his point of view is very different from that of the engineer. This difficulty has been overcome in the present work by separate authors contributing chapters on the different sections of a complex subject, each writer being a specialist in his particular branch—an admirable arrangement. If there is a certain amount of overlap it helps rather than detracts from the utility of the book, the skilful manner of general editing leaving just enough to the imagination.

"To organise effectively has ever been one of the major problems of mankind in all man's multifarious activities" is certainly true, and the authors show how this organisation involves not only the lay-out of the factory, but the organisation of business control as well as of production, and necessitates a knowledge of the principles and practice of industrial relations, each of these phases having a chapter to itself, while others are devoted to marketing and advertising, to selling and transport, and to records and costing, a comprehensive bibliography completing a very useful volume.

It would obviously be impossible within the limits imposed to treat a vast subject in great detail, but the whole is set out in a concise and suggestive manner, so that a business man can readily base his organisation on the general principles enunciated, modified or developed to suit his particular requirements. It has been said that a man who is a skilled mechanician can be obtained for a very low figure, and a man with an honours degree more cheaply still; but when the latter is coupled with a knowledge of business methods and an insight into the psychology of the worker, the value of such a man is of a very high order. Unfortunately, our universities do not at present pay much attention to this side of training, although they certainly are improving; but the student who has completed his theoretical course should find no difficulty in studying "Factory Organisation" and thereby greatly benefiting.

We naturally read the book with an engineering factory in our mind, and in so doing are prone to criticise certain statements as incorrect—as, for example, that it is increasingly becoming the custom for employers to grant a week's leave with pay to all employees—but the authors do not specify the type of work they have in view, although their experience has probably been acquired largely in one of the big factories that produce some of our most popular confections, a type of product closely analogous to engineering mass production.

Although the authors claim to maintain an open mind as to which is the best of the three recognised principles of organisation—departmental, staff and line, or functional—they seem to incline to the last mentioned, and if this be so the reviewer is in agreement with them, the only danger lying in the tendency for functions to overlap. In that connection we are particularly interested in the suggestion that duties should be graded so as to show clearly the degree of supervision covered by the title, and the organisation unit controlled. Thus in a tentative table we notice that while a general manager exercises co-ordination over an organisation, a junior foreman only exercises oversight over a group. But we have a good way to go before it will be possible to ensure conformity even in the matter of titles.

We should like to have seen some indication of the type of individual considered best suited to control the different functions, feeling as we do that an engineer, who has also had a good business training, is the best man to put in charge of the stores department or to be sales manager in an engineering factory, although we are aware that many authorities would join issue with us.

It is gratifying to find that stress is laid on the necessity for cordial relations between employer and employed, and to read that good wages must be paid "up to the limit that the industry can afford." Too often so-called organisers begin by reducing wages instead of tackling a reduction of oncost. We are given the definition that "psychology is organised common sense," and it should surely teach us that no organisation can be efficient if it produces dissatisfied workers.

The value of costing is clearly shown, and while we have sometimes been driven to the conclusion that cost accountants believe that the factory is in existence for their special benefit, whereas no costing system can of itself "produce the goods," although invaluable to a progressive management, we fully endorse the opinion that "it is important that the manager's time should be conserved by arranging the records submitted to him so that the points needing his attention should stand out." We read that "a costing system can help greatly provided it functions effectively in time of adversity, when it is most needed." Emphatically we agree, but confess to a degree of scepticism as to whether such a system has yet been perfected!

Altogether there is much food for thought, and many helpful suggestions in "Factory Organisation," and we have enjoyed the perusal of it.

SHORT NOTICES.

Wireless Principles and Practice. By L. S. Palmer. London: Longmans, Greens and Co., Ltd. 1928. Price 10s.—We take it that Mr. Palmer is at heart a mathematician. Now mathematicians see in all science and technology an opportunity for the exercise of their talent. Hence we find in this volume more attention to the mathematical side of wireless than the average reader is likely to relish, and more, we may add, than seems to us to be called for. It is well known that wireless apparatus is, in many respects, very accommodating with regard to "values"; precise calculations are, therefore, rarely necessary, and the practical designer can do nearly all the essential figuring with a few very simple algebraical and arithmetical expressions. That is because, in the end, "wireless" has to be received by the ear, and there is no such thing as a standardised ear, and there is never likely to be one. Apart from this marked addiction to mathematics—often of the higher order—Mr. Palmer covers the whole field of wireless very thoroughly and shows his practical acquaintance with it by many sound observations. Indeed, if he would bring out an edition of the work with the advanced mathematics left out an attractive text-book would still remain. May we, however, take this opportunity to lodge a very gentle protest against the misuse of the little word "due," which is particularly common amongst wireless writers. Mr. Palmer offends much less than most writers, but even he forgets sometimes that "due" is an adjective, and uses it wrongly, as, for example, in "will be sloping in the reverse direction *due* to the gradual leaking of the charge." We submit that "owing" is a much better word in that position.

R's Method of Using Ordinary Set Squares in Drawing and Design. By Harry W. Roberts. London: The Architectural Press. 1927. Price 6s.—In this little book Mr. Roberts demonstrates the numerous purposes to which ordinary 60 deg. and 45 deg. set squares can be put by the draughtsman. It is apparently addressed rather to architects than engineers, and we do not pretend to say how much real service Mr. Roberts' ideas may be to the former; the latter we suspect will stick to the traditional methods of dividing lines, drawing parabolas and hyperbolas, and so on, though he may find it an interesting recreation to work out some of the author's problems. Modern artists of the "cubist" variety will no doubt derive help and satisfaction from Mr. Roberts' method of drawing the human face and figure by the aid of set squares.

BOOKS RECEIVED.

Applied Elasticity. By S. Timoskenko and J. M. Lessells. London: Constable and Co., Ltd., 10–12, Orange-street, W.C. 2. Price 25s. net.

The Port of Hamburg. By Dr.-Ing. L. Wendemuth and Dipl.-Ing. W. Böttcher. Hamburg: Meissner and Christiansen, Germany.

The Manufacture of Artificial Silk. By E. Wheeler, London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 12s. 6d. net.

Werkstoff-Handbuch-Stahl und Eisen. Düsseldorf: Verlag Stahleisen, m.b.H., Breitestrasse 27, Schliessfach Nr. 664, Germany. Price 24 marks.

A Manual of Field Astronomy. Second edition. By A. H. Holt. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 10s. net.

The Design and Construction of Dams. Eighth edition. By E. Wegmann. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 87s. 6d. net.

Continuous Current Engineering. Third edition. By Alfred Hay, D.Sc. London: Constable and Co., Ltd., 10–12, Orange-street, W.C. 2. Price 14s. net.

Industrial and Railway Amalgamations. By Sir Josiah Stamp, G.B.E., LL.D., &c. London: London General Press, 3, Arundel-street, W.C. 2. Price 2s. net.

Directory of Shipowners, Shipbuilders and Marine Engineers, 1928. London: The Directory Publishing Company, Ltd., 33, Tothill-street, S.W. 1. Price 20s. net.

Protective Metallic Coatings. By H. S. Rawdon. New York: The Chemical Catalog Company, Inc., 419, Forth-avenue, 29th-street, N.Y., U.S.A. Price 5.50 dollars.

Wireless Direction Finding and Directional Reception. Second edition. By R. Keen. London: Iliffe and Sons, Ltd., Dorset House, Tudor-street, E.C. 4. Price 21s. net.

The Centrifugal Pump and its Applications. By M. Heath. The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 2s. net.

The "Unsaturated Hydro-carbons" in the Gases from the Carbonisation of Coal. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 6d. net.

The Blue Book, 1928. The Directory and Handbook of the Electrical Engineering and Allied Trades. London: Ernest Benn, Ltd., Bouverie House, 154, Fleet-street, E.C. 4. Price 25s. net.

Powering of Ships, Design of Lines and Screw Propellers. By A. Kari. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 2s. net.

Safety Precautions for Transmission Machinery in Factories. Part II., Belt Mounting. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

Report of the Proceedings of the World Motor Transport Congress, 1927. London: The Organiser, the World Motor Transport Congress, 21, Northumberland-avenue, W.C. 2. Price 7s. 6d. net.

The Electrical Conductivity of the Atmosphere and its Causes. By V. F. Hess. Translated from the German by L. W. Codd. London: Constable and Co., Ltd., 10–12, Orange-street, W.C. 2. Price 12s. net.

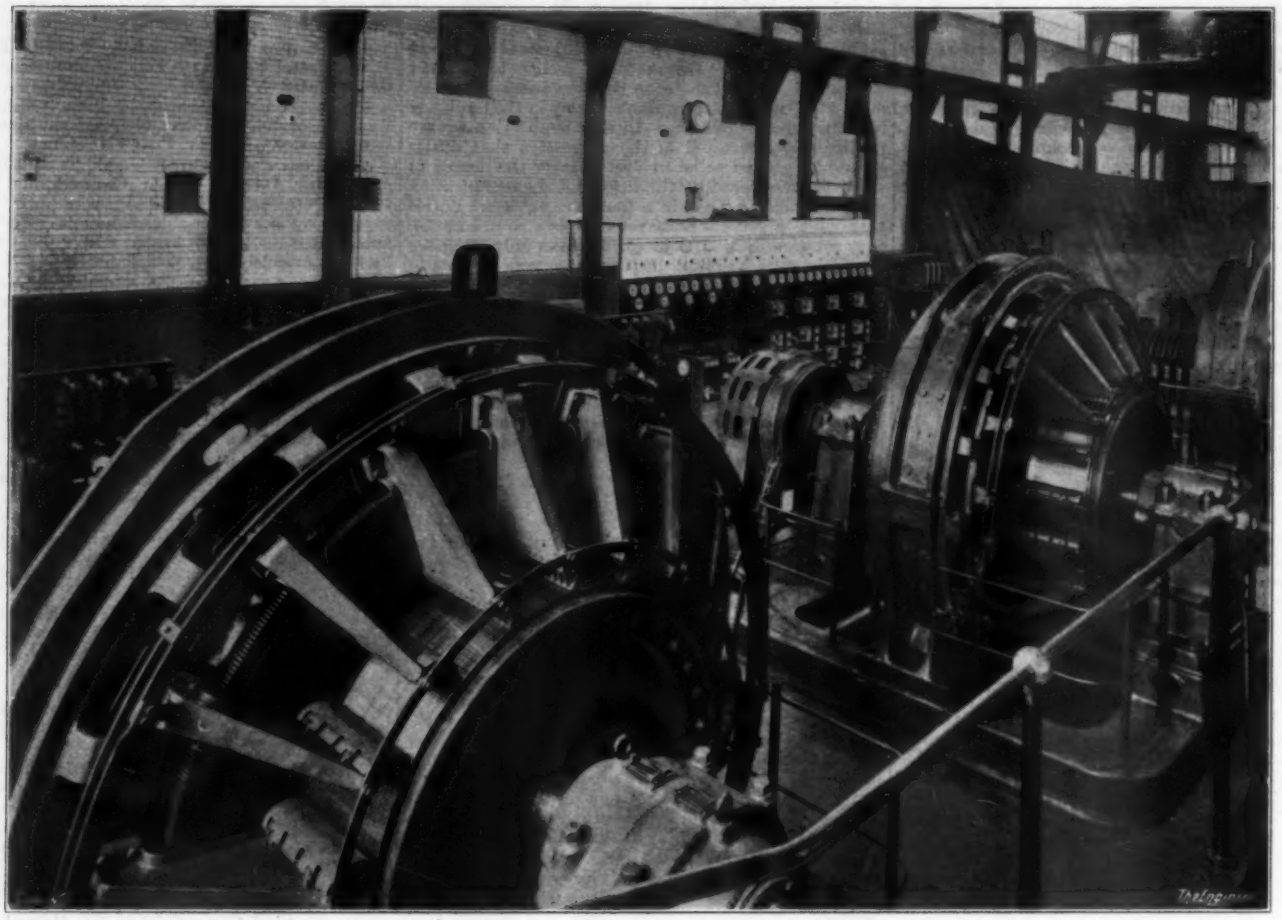
Report on the Handling of Fuel, Lay-out of Engine Changing Stations and other Miscellaneous Developments in the United States of America. By R. C. Case. London: The Office of the High Commissioner for India, 42, Grosvenor-gardens, S.W. 1. Price 5s. 6d. net.

SIXTY YEARS AGO.

IF we would appreciate properly the outlook of the engineers of sixty years ago we must pay due attention to the facilities then existing for technical education. Those facilities were extremely poor. British universities and public schools were still dominated by the doctrine that the languages of the dead and buried Latin and Greek pagans represented the most desirable summit of human knowledge to which to direct the steps of their pupils and students. In our issue of February 14th, 1868, we poured scorn on the system which placed a knowledge of the classics first and of other subjects nowhere. Rusty and musty and dusty and fusty were the men, we wrote, who forced poor boys to delve for ten or twelve long years in the mud of Paganism and then turned them out into the great world as ignorant of anything but cricket and athletic sports as it was possible for human animals of their age to be. The boys grew into men who lived in the houses of their fathers, whence they issued to hunt foxes, attend horse races or to govern the nation. They felt fit to govern the nation because they had been taught to believe in the pitiable ignorance of agricultural labourers and others who could not talk Latin. But beside the worshippers of dead languages a new race of men, we noted, was to be seen, men who had tracked the stars in their courses and who had forced the sun, moon, and earth to yield up some of their richest secrets. The worshippers of the past were watching the uprising of the new race with fear and trembling. The small but powerful knot of scientific men was becoming aggressive, and the hollow idols of the schoolmaster were being turned topsy-turvy and their emptiness exhibited to all who chose to look. Tyndall, Mill, Huxley, Gladstone, and Farrar were heading the scientific side in its assault on the old-established strongholds. They were being opposed by prejudice, stupidity, and in a few cases self-interest, but we prophesied that the old system would, under their onslaughts, be forced to take its happy dispatch. We saw the beginnings of the new era in the fact that Oxford University was undertaking the publication of some standard technical works by Sir William Thomson, Dr. Balfour Stewart, and other philosophers, and in the fact that London University was beginning to confer degrees in science and was lessening the stringency of its examinations in Latin and Greek. At Glasgow University, we noted with particular approbation, Sir William Thomson was teaching science in a new way, namely, by making his students perform experiments with their own hands instead of acting the part of mere spectators.

THE HORSEFERRY ROAD ELECTRIC SUB-STATION

MR. P. L. RIVIERE, M.I.E.E., WESTMINSTER, ENGINEER



The Horseferry-road Sub-station.

LIKE various other direct-current generating stations in London and elsewhere, the Horseferry-road power station of the Westminster Electric Supply Corporation has been converted into a sub-station and the original generating plant has been replaced by rotary converters, which are said to be larger than any machines of this type previously used in this country. There are four machines, each rated at 3000 kilowatts capacity. Two were supplied by the Metropolitan-Vickers Electrical Company, Ltd., and two by the British Thomson-Houston Company, Ltd., the former firm also having supplied metal-clad high-tension switchgear and metering equipment. The high-tension supply to the station is derived from the 22,000-volt distribution system of the London Power Company. Four high-tension feeders are connected to the station, two from the Pelham-street sub-station and two from the Amberley-road sub-station.

The Metropolitan-Vickers rotary converters are standard shunt-wound three-wire machines, designed for starting in accordance with the company's patented self-synchronising system, which ensures correct polarity. They run at 333 revolutions per minute, and have a direct-current pressure range of 400–460 volts. As the machines are rated at 3000 kilowatts, the current output at 440 volts is 6818 ampères, and in accordance with B.E.S.A. specification No. 172, they are capable of giving their full output at 430 volts. Other requirements of this specification are also met, such as an overload of 25 per cent. for two hours, 50 per cent. for fifteen minutes, and 100 per cent. for fifteen seconds, after a full load run in each instance.

A general view of part of the station is given above, whilst Fig. 1 shows the high-tension control board with mimic bus-bar indicators. The overall length of each rotary converter is over 16ft., the width 12ft., and the height above the floor level 11ft. The weight of each machine is 38 tons. End shields extending over the windings reduce windage and noise. Hinged sheet steel guards on the direct-current brush gear protect the brush flexible leads and springs in the event of heavy short circuits producing flashing on the commutator. Barring gear enables the armature to be turned round for cleaning purposes. The makers' standard self-synchronising motors have solid cast steel indestructible rotors, the starting torque of each motor being equivalent to that of a machine developing 450 horse-power at full speed. In order to deal with the heavy starting currents, the starting panels are equipped with contactors connected in series with the motor and arranged to open before and close after the usual three-pole change-over switch. One of the "Metrovick" transformers which supply current to the rotary converters is shown in Fig. 2. The transformers, which are rated at 3000 kVA, take three-phase 50-cycle current at 21,800 volts, and give a six-phase supply to the rotaries at a pressure of 324 volts. Tappings giving voltages of plus and minus 5 per cent., are provided on the high-tension windings, and there is also a mid-point tapping for the three-wire direct-current distribution system. The transformers are of the core type, with spiral low-tension windings and disc wound high-tension windings, which are provided with the maker's spring dashpots for tightly clamping the coils. Both windings are composed of paper-covered wire, and are immersed in boiler plate oil tanks with detachable radiators. Single-pole sealing bells are provided for the high-tension cables. The copper strip low-tension connections to the rotaries are interleaved to minimise eddy current losses. Cambridge index thermometers show the oil temperatures in each tank.

The "Metrovick" high-tension switchgear is a good example of modern practice, with metal-clad compound filled gear. In all there are ten circuit breakers, each having a breaking capacity of 500,000 kVA. Four of these units control the duplicate 22,000-volt feeders from the Pelham-street and Amberley-road sub-stations; four the supply to the rotary converters; and two are for bus-bar coupling and sectionalising. The circuit breakers are controlled on the remote system from the ten-panel control board

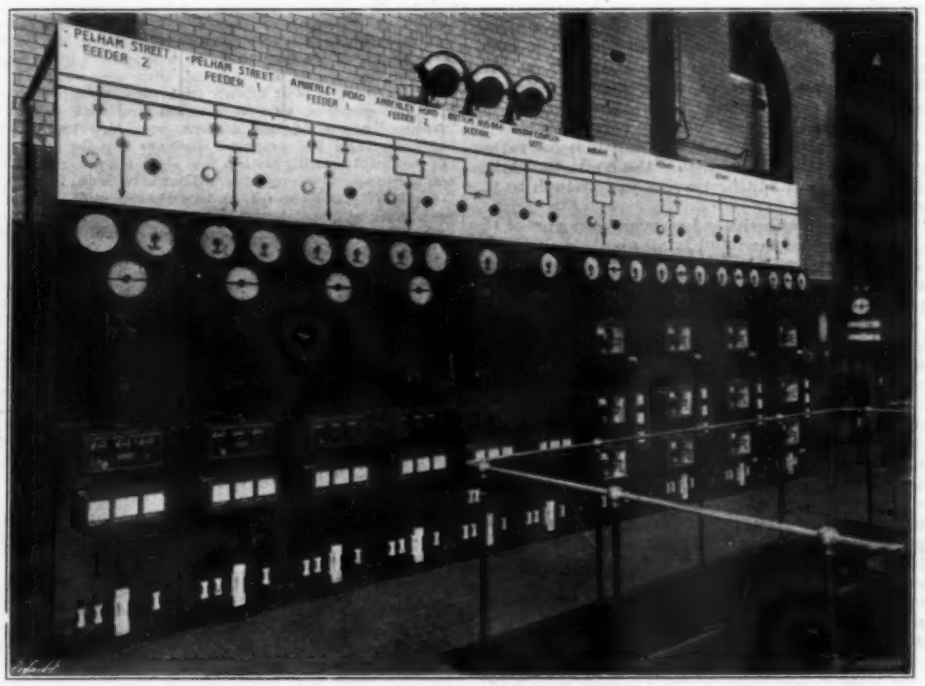
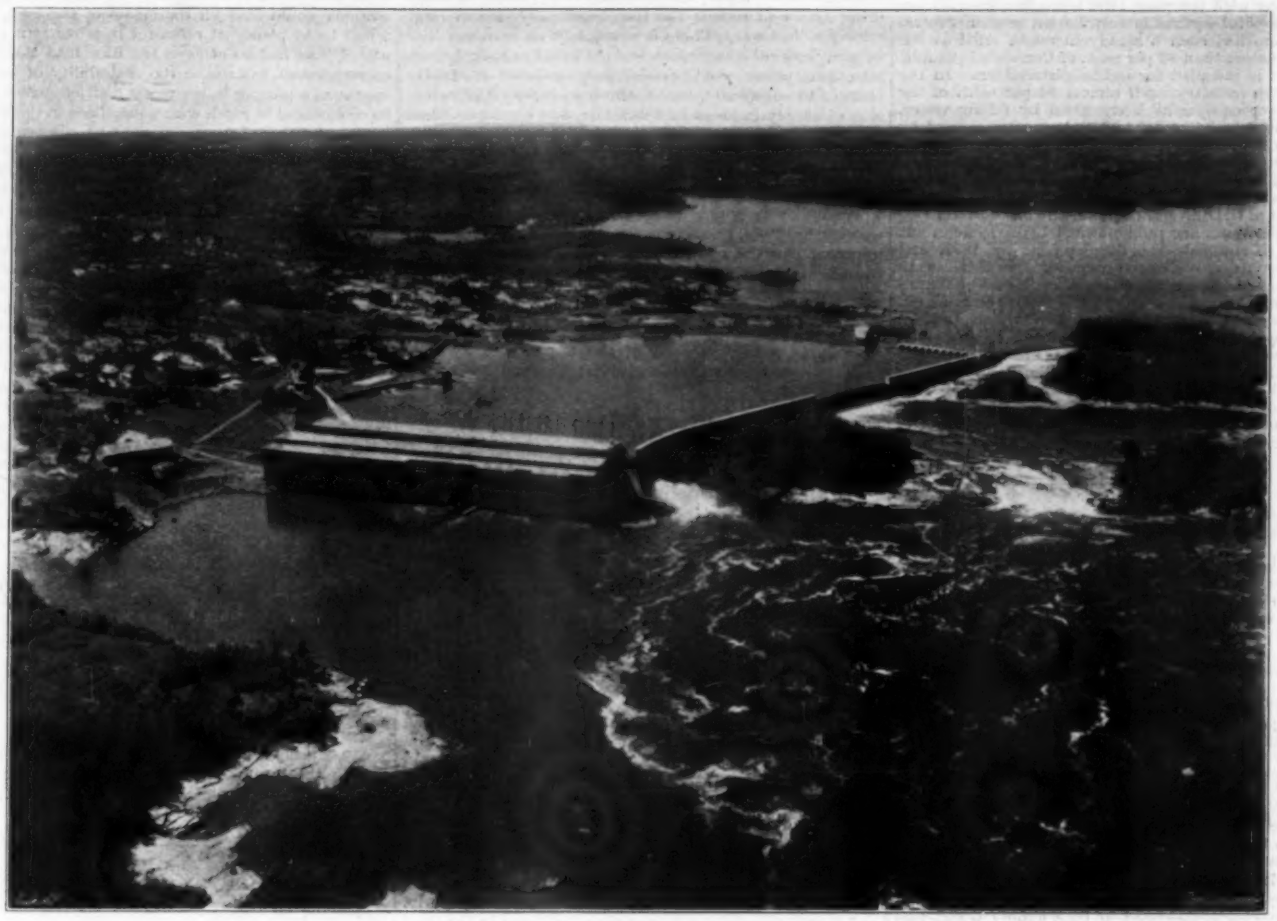


FIG. 1—HIGH-TENSION CONTROL BOARD

POINTE DU BOIS POWER PLANT ON THE WINNIPEG RIVER



shown in Fig. 1. This board is situated in the machine room, and the mimic diagram shows the position of all the circuit breakers and isolating devices. The installation includes a complete system of protective relays arranged so that the automatic tripping of any switch operates a Klaxon signal, and at the same time lights a green indicating lamp on the control panel affected. A white lamp on each control panel indicates the working condition of the trip circuit of the circuit breaker. The Metropolitan-Vickers Company

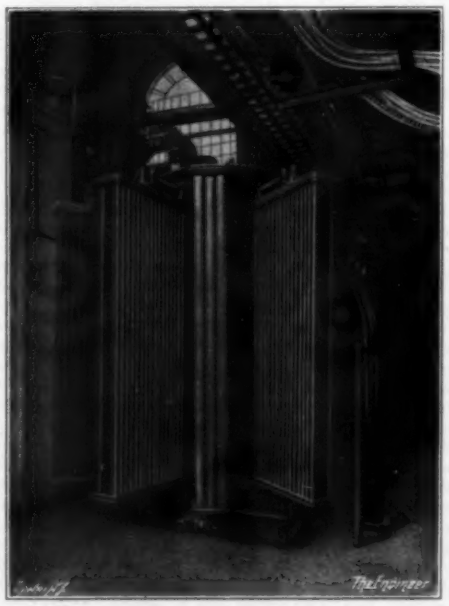


FIG. 2—3000 kV.A. TRANSFORMER

has also been responsible for the installation of metering equipment, which measures the supply to each rotary converter by three Thomas averaging recorders. The potential and current trasnformers for this equipment are installed in a basement below the switch units, whilst the recorders are mounted on the rotary converter panels of the control board. The installation of the sets was carried out to the specification of Mr. P. L. Rivière, engineer-in-chief to the Westminster Electric Supply Corporation.

Water Power Development in Canada.

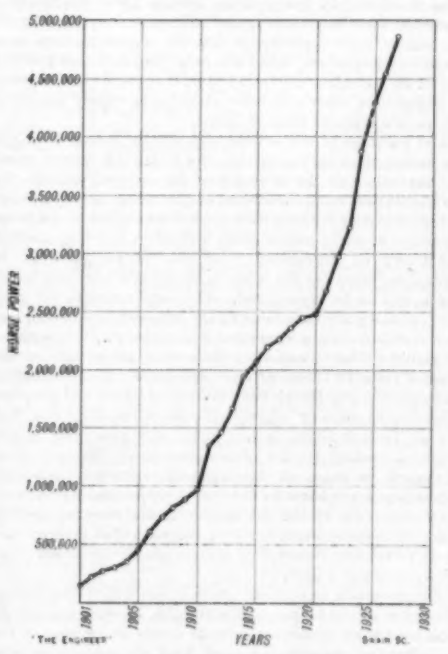
WATER-POWER plants in Canada have now reached a total turbine installation of 4,883,266 horse-power. If the present rate of increase continues, the turbine installation will easily have passed the 5,000,000 horse-power mark by the end of 1928, according to statistics compiled and just issued by the Director of the Water Power Branch of the Department of the Interior, and as may be inferred from the accompanying curve.

As indicating the rapid growth of hydro-electric development in the Dominion, it is pointed out that in 1900 the total installation amounted to only 170,000 horse-power. During the subsequent decade that development grew to 975,000 ; at the close of 1914 it was 1,946,000, and at the end of 1920 it had increased to 2,508,000 horse-power. As further evidence of Canada's present possible installation, Mr. Johnston says :—" It is not correct to subtract the total installation at November 1st—4,883,000 horse-power—from the totals of available power to determine what power remains undeveloped, as investigation has shown that throughout the Dominion the installations at developed sites exceed the estimates of ordinary six-month power at such sites by about 30 per cent. On this basis the total recorded resources of Canada would warrant the installation of about 43,000,000 horse-power. In other words, the present turbine installation represents slightly more than 11 per cent. of the total resources.

The total capital invested in the water-power industry in Canada at this date is estimated to be 900,000,000 dollars or more than that of any other single manufacturing industry. The corresponding figure in 1910 was 121,000,000 dollars, so that the increase in seventeen years is over 600 per cent. This total includes the cost of the primary and auxiliary power plants, transmission and distribution systems with land, machinery and equipment. Applied to the existing installation, it amounts to an average of 183 dollars per horse-power, and, in view of the steady earning power shown by the industry even in times of industrial difficulty and depression, it would appear that this capitalisation is reasonable and one which the industry is well able to carry. Two of Canada's rapidly-expanding industries—pulp and paper, and mining—are becoming tremendous users of hydro-electric energy. The pulp and paper mills, it is now estimated, have a total hydraulic installation in connection with the mills themselves of 526,731 horse-power, while the additional hydro-electric energy purchased by this industry from central electric stations is estimated at over 831,000 horse-power, making a total utilisation of 1,358,052 horse-power.

The highly industrial but non-coal producing provinces of Ontario and Quebec contain over 60 per cent. of Canada's potential water power, while the rapid change from agricultural to industrial predominance has led to the installation in these two provinces of over 80 per cent. of the country's total hydraulic development, representing an installation in Quebec of 832 horse-power and in Ontario of 573 horse-power per 1000 of population. British Columbia, with a comparatively small population but large power-consuming industries, viz., pulp and paper and mining, occupies third place in order of total installation, and is a close second to Quebec in *per capita* installation. Manitoba, fourth in population and total installation, has a *per capita* installation of 394 horse-power per 1000 of population.

The Maritime Provinces, not so bountifully supplied with water powers, yet having more than sufficient for present needs and ample to provide for normal industrial expansion in the future, have in Nova Scotia an installation of 65,702 horse-power ; in New Brunswick, 47,231 horse-



GROWTH OF CANADIAN HYDRO-ELECTRIC POWER

power ; and in Prince Edward Island, 2274 horse-power. Abnormal conditions in the Yukon, with a small population and heavy power demand for low grade gold mining, result in the total installation of 13,199, showing a utilisation of 1100 horse-power per 1000 of population, a figure, of course, not comparable, on account of the conditions mentioned, with the corresponding figure of the other Provinces.

Canada's central electric station industry, the generation or distribution of electric energy for public use, has attained record proportions because the wide distribution and accessibility of her abundant water powers is such that with modern methods of transmission, electricity for

industrial and domestic purposes is available to all but a very small proportion of the population. The development of water power for central station use was practically coincident with the solving of the problem of high-tension transmission little more than a quarter of a century ago, and beginning with the year 1900 when less than 33 per cent. of the total hydraulic installation was in central stations, there has been a steady increase, until at the present time more than 82 per cent. of Canada's hydraulic development is installed for public distribution. In the central station industry itself almost 96 per cent. of the primary power equipment is energised by falling water, while the diversity of use of hydro-electricity induced by moderate prices results in almost 99 per cent. of the total electrical output being generated in the hydraulic stations.

Another big water power project will be commenced in Canada next spring, when a start will be made on the development of the Slave Falls power site on the Winnipeg River, for the Winnipeg public-owned hydro system. It is planned to complete the development by 1931, and present estimates involve an expenditure of close to 7,000,000 dollars. The site is 90 miles north-east of Winnipeg and 5 miles from the Pointe du Bois plant of the Winnipeg hydro system. This plant, which has an installed capacity of 105,000 horse-power, is shown on the accompanying half-tone engraving. Present plans also call for the building of a railway from the Pointe du Bois to Slave Falls. There is available at the Slave Falls site a total of more than 36,480 continuous horse-power under conditions of ordinary minimum flow, and more than 60,000 horse-power at ordinary six-month flow.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE USE OF DIESEL ENGINES FOR PEAK LOAD SUPPLY.

SIR,—An article, under the title given above, in your issue of January 20th deals with a subject of great interest to the smaller electricity supply undertakings whose average costs of electricity to be purchased under the new scheme will be seriously affected by the additional charges above the low grid tariff which will result from the transmission of peak load demands over secondary lines. It is understood that the 132 kV lines will not be tapped for smaller demands than 10,000 kW, so that it follows that in a large number of cases bulk supplies to authorised undertakers will be given indirectly through secondary lines.

Many supply engineers, including representatives of power companies experienced in bulk supply work, who recognise the advantages to be gained from the generation of base load electricity on a great scale at a few points interconnected by a super-tension transmission grid to render supplies available throughout the country, and who hesitate to raise any unnecessary din about details at a time when the authorities are engaged on the tremendous work of inaugurating the scheme, feel convinced that the apparent policy of deliberately suppressing the use of heavy oil engines as auxiliaries is wrong, because, as stated by your correspondent, such a policy will retard the reduction of electricity prices and restrict the extension of supply in many areas remote from the densely loaded large urban centres, and will react unfavourably on the competitive capacity of our oil engine makers in a growingly important world market. Moreover, as pointed out in Mr. Geoffrey Porter's letter, it ignores the tendency of practice in other countries where bulk supply measures are more advanced than at home.

The purpose of the article will not be served if in the discussion thereon claims for the heavy-oil engine upon the attention of the authorities are carried outside the justifiable and moderate limits set by your correspondent. The problem of dealing with peak loads under the scheme generally must be one of great difficulty, and the inherent suitability or unsuitability of any particular type of generating plant for the work in question is only one factor which has to be considered. The requirements for peak load capacity are enormous in the London area alone, and where steam-driven generating stations of the requisite magnitude already exist on the spot it seems idle at the present time to think of any alternative to the employment of them, although they are not ideal for the purpose. Your correspondent rightly advocated making the best use of both existing steam plant and heavy-oil engine plant, according to the circumstances of different areas in regard to stage of development, situation and load conditions, and pleaded only that a pre-eminently suitable auxiliary, such as the oil engine is for meeting certain common requirements, small in magnitude at present, but likely to become important, should not be discarded practically without a trial.

The specially important purpose for which the heavy-oil engine would be peculiarly suitable in connection with peak load work under the scheme is the prevention of the necessity for transmitting peak load demands over long distances. Everyone hopes that the operation of the scheme will develop a general use of electricity throughout the length and breadth of the country. This will lead to the growth of heavy peak loads at points remote from the existing steam-driven stations allocated to peak load service. The little boom in direct electric heating during the cold snap in December last gave an indication of how serious the effect of peak load may become in connection with the power charges of two-part bulk supply tariffs, especially where secondary transmission is involved. Some undertakings already purchasing partial supplies in bulk, and possessing heavy-oil engines, had practical demonstration of the great value of these engines in this connection. It seems fundamentally wrong to propose to transmit tens of thousands of kilowatts at load factors of under 5 per cent. over long primary and secondary lines when heavy-oil engine plant at the outlying peak load centres could be made use of to supply the low load factor units at much lower cost and relieve the transmission system of large unprofitable loads. There is absolutely no question that in many cases the continuance of the use of existing heavy-oil engine plants would render possible lower electricity charges to consumers, and conduce to more rapid extension of supply in areas in which they are employed, than would be the case if they were shut down. Moreover, in many cases there would ultimately be an overall gain were additional oil engines installed to prevent the necessity for the duplication of secondary transmission lines.

The bulk supply purchaser's case for the preservation of existing heavy-oil engine plant for peak load and stand-by purposes may be supported by comparing a deduction from figures which will shortly be published in the report on Heavy-Oil Engine Working Costs by the Diesel Engine Users Association, with the combined average cost per unit generated set down for the last eleven steam-driven stations listed on page 84 of the Supplementary Particulars issued with the South-East England Electricity Scheme, 1927.

Results of Forty-one Heavy-Oil Engine Stations Varying in Capacity from 3330 kW. to 150 kW. during the year 1926–27.

Maximum load carried	24,483 kW
Units generated	44,060,000
Load factor (calculated on maximum load and U.G.)	20·5 per cent.

	Total engine-room costs. £	Average cost per U.G. d.
Fuel	64,963	0·353
Lubricating oil	12,017	0·065
Water and stores	3,841	0·021
Wages	30,657	0·167
Repairs and maintenance (including labour)	19,728	0·107
	£131,206	0·713

The average number of hours run by each of the 142 oil engines during the year was 2155.

The combined load factor of the steam-driven stations mentioned above set down for the year 1933–34 is 1·88 per cent.

Assuming that the above-mentioned forty-one oil engine stations were restricted to purely peak load running at a combined load factor of 1·88 per cent., the corresponding output would be, at the same maximum load, 4,033,000 units. The running hours would be much less than formerly, and it would be fair to assume that the items in the total costs for water and stores, wages and repairs and maintenance would be halved. The engine-room cost for 4,033,000 units would under the assumed conditions then be approximately :—

	£
Fuel and lubricating oil, 0·418d. × 4,033,000	7,030
Water and stores	1,921
Wages	15,328
Repairs and maintenance	9,864
	£34,143
Average cost per unit generated	2·03d.

The figures set down for the eleven steam-driven stations cited are :—

For the Year 1933–34.

Output. Million units.	Cost. £	Average cost per U.G. d.
48·4	1,094,429	5·42

At a grid tariff of £3·8 per kilowatt, plus ·2d. per unit, the average charge for supplies at 1·88 per cent. load factor would be 5·73d. per unit, and to the grid price in the cases of indirect supplies would have to be added the costs of secondary transmission. On a small quantity of electricity like 4,033,000 units, the difference between 5·42d. and 2·03d. per unit represents an amount of approximately £57,000 in favour of the oil engines. This would be a very useful annual sum if devoted to development.

The rub experienced in putting forward figures like these is the reflection that the scheme must be considered as a whole, and not only from the point of view of the comparatively small bulk supply purchaser. Buyers who expect or hope to enjoy a secondary unit charge of the order of 0·2d. may as a general principle be expected to bear their fair shares of the overhead charges of the complete equipment. It is realised that the effect of allowing owners of the existing heavy-oil engine plants above mentioned to continue the operation thereof would result in the grid losing revenue to the extent of not less than £96,000 for the year 1933–34, against a saving of about £3000, as the steam-driven peak load stations would have to run with much the same complement of plant, whether the oil engines were in use or not, the capacity of the latter being so small in proportion to the total required, so that the saving in cost to the main system would only be that of the coal cost of the units involved, a small matter compared to the proportion of overhead charges which would be deducted from the grid revenue due to the use of the local oil engines. This is one plain aspect of the matter, but there are others which are not so clear, and are still worthy of consideration. For instance, it is a question whether strict morality does require the smaller outlying undertakings to pay very dearly for the accidental circumstances which necessitate the use of steam-driven stations which happen to be available on the spot for dealing with the peak loads in London and the larger urban areas. Then the question arises as to whether the loss in revenue to the grid due to allowing the oil engines to be run for peak load purposes would not be more apparent than real. It seems certain that if local economies by means of the use of oil engines were encouraged, development would be accelerated. Every new main embarked upon as the result of savings would bring a new high load factor component to the demand. The super-stations would take all the cream of the load, and there seems to be plenty of room for improvement in the estimated load factors of even the base load stations. Your correspondent dealt with the desirability of using the oil engine as a pioneer in the many districts which it will not be economical to reach with power lines in the near future, and the bearing of the use of oil engines in connection with secondary transmissions in the directions of obviating the duplication of lines would be well worth reviewing. The indications are that the costs of secondary transmissions are going to entail serious additions to the grid prices.

A great deal is said about the saving of coal which might result from the desired use of oil engines. It all depends what is meant by saving coal, whether or not the plea will carry much weight. The restriction of the efficient use of coal and more coal is certainly not to be desired in this country, and any unnecessary extension of the use of imported oil is not a desideratum either. But, fortunately, the amount of coal or oil fuel involved in this peak load question is not large, and the probability is that were the undoubted advantages of the heavy-oil engine for certain purposes of the electricity scheme recognised and the use of these engines encouraged and extended, a good deal more coal would be profitably used by a thriving oil engine industry strengthened by a home market to maintain itself in a valuable overseas trade than would be "saved" by generating a suitable proportion of the required peak load units by means of oil engines instead of by steam turbines.

The subject raised by your correspondent is a very complicated one, but is well worthy of reconsideration before final decisions about shutting down oil engine generating stations are taken.

C. O. MILTON.

Maidenhead Corporation Electricity Works,
February 8th.

SIR,—Your correspondence columns of February 3rd denote the peculiar position of oil engine stations and oil engine development in this country, as they exist in regard to the Electricity Bill.

The aspects of the case from a peak load point of view and the undeniable economies of the oil engine will remain unchallenged, and the figures quoted by Mr. Porter would undoubtedly be improved in modern power stations employing oil engines.

From carefully chosen results obtained by modern high-power oil engines, the following figures can be achieved and maintained over a working period of five years, assuming a load factor of, say, 30 per cent. :—

Fuel	·26
Lubricating oil	·022
Stores and water	·013
Wages	·075
Repairs and maintenance	·025
	·395

The effect of shutting down oil engine stations is not only a serious blow to those boroughs which have by their foresight carried on for years without steam, but the sequel of it all is, or may be, a national calamity.

Great Britain proudly possesses a larger experience of the oil engine than any other country, and British firms are just embarking on the larger land type engines to compete with their continental neighbours. Germany, with State support, is investigating the economic position of a 10,000 kW oil engine unit in comparison with steam. Britain, on the verge of building larger oil engines, may become impotent owing to the restricted development consequent on the apathetic attitude shown by the country to the use of oil engines for land purposes.

We are two years behind our continental friends in investigating the economies which may be brought about by the low temperature carbonisation of coal, for it is only recently that the Government has advanced £100,000 to the Gas Light and Coke Company for a plant to investigate the above system.

Naturally it is the duty of this nation to conserve the use of its potential wealth in coal. The use of fuel oil, as well as other by-products from low temperature carbonisation, might then be a stepping-stone in the direction of the use of large oil engines in super-power stations in this country, and prove an important factor in the production of cheap power, even if only for the use of peak loads. An analogy may almost be found when we compare the tremendous development of the oil engine at sea with its contemporary steam. Would the shipowners of to-day be in the enviable position they are had there been an authority to enforce steam as a compulsory method of propulsion instead of large oil engines? If these oil engine ships show an economy over the steam, surely the same argument, to a large extent, can be applied to land power stations.

If the Government would authorise the appointment of a Commission to investigate the possibilities of cheaper fuel, say, furnace oil, in large power stations and analyse the situation accordingly, the country and those engineers who have built up British prestige and trade on internal-combustion engines for the last thirty years would feel at least that their courage and contribution to the nation's progress would at last be receiving fair consideration and not be left in sad isolation. May I therefore suggest that the public have a right to expect any information of facts and figures as they apply to the generation of power as carried out to-day or in the future by oil engines, and also

that the Government should show by figures the comparison as applied to the four following conditions :—

(1) Steam turbines.
(2) Steam turbines with oil engines for use on peak loads.
(3) Steam turbines and oil engines, say, 50 per cent.
(4) Oil engines (high power) 2000/15,000 kW.

February 9th. A RATEPAYER.

WATER POWER AND THE ENGINEERING SOCIETIES.

SIR,—The plea in the January number of *Water and Water Engineering*, for the formation in due season of an "Institute of Hydro-electric Engineers," is of considerable interest, in view of the leading article in THE ENGINEER of December 16th, 1927, under the heading of "The Federation of Engineering Societies."

The complexity of the problems met with in "Water Power Engineering" is such that there is an urgent need for a better means than exists at present of interchange of views and knowledge on the various civil electrical and mechanical features which combine to make a complete hydro-electric plant. While this branch of engineering is extremely interesting, and while hydro-electric contracts are amongst the largest given out in the engineering world, the number of engineers who can qualify that title by the prefix "Hydro-electric" is very small. Their number might be enough to form a small society, but would not warrant the expense of an organisation such as those of the premier Institutions.

The difficulty of those in the water power world in finding some means of fraternising would clearly be met were "The Federation of Engineering Societies" an accomplished fact. As it is, they have so much in common with civil, mechanical and electrical engineering alike that it is indeed difficult to know with whom any hydro-electric group should seek to ally itself. The mechanical portion of a hydro-electric plant is a comparatively small portion of the whole, the electrical portion does not vary to a great extent in design except so far as the generators are concerned, as compared with the general practice adopted in steam stations. It would seem, therefore, that the greatest need for co-operation exists between the hydro-electric engineer and the civil engineer.

There is still a further field of engineering in which the hydro-electric engineer feels the need of co-operation, namely, the field of electro-chemistry and electro-metallurgy, and the general study of the manufacture of a market for power, a study which is far more essential to the hydro-electric engineer than to his steam-electric *confrère*. A knowledge of the possibilities of electro-chemistry and electro-metallurgy might quite possibly justify the creation of a power supply in places where, to all appearances, it would seem to be commercially impossible, and much of the labour of man in wild and difficult places might thereby be simplified.

Water power engineers should certainly have some sort of society, but where should such a society find a home, where records can be kept and wisdom stored and dealt out and papers on allied subjects be read? One asks whether it is not possible for one of the existing institutions to offer them shelter regardless of their creed and sect, as men who are doing most useful pioneering work in a field which is at present fenced about with so many difficulties and disappointments. D. S.

February 11th.

"EQUIVALENT BENDING MOMENT" AND "EQUIVALENT TWISTING MOMENT."

SIR,—The terms "Equivalent Bending Moment" and "Equivalent Twisting Moment" have been in use for many years in connection with the design of round shafts subjected to the combined action of bending moments and twisting moments, and a reference to them is to be found in most of the standard text-books.

There is very much to be said, on mathematical grounds, against the employment of such terms, as under no circumstances can a simple bending moment or a simple twisting moment give the same stress system in a shaft as a bending moment and twisting moment combined. Nevertheless, as an artifice for getting rapidly a required result, there is, subject to their proper definition, a good case for their use. It is, however, in this matter of definition that the usual treatment to be found in the standard text-books is somewhat unsatisfactory, leading to confusion of thought, particularly in the minds of those approaching the subject for the first time.

If M is the bending moment and T the twisting moment in a shaft, the expression

$$\tfrac{1}{2}(M + \sqrt{M^2 + T^2})$$

is usually called the "equivalent bending moment." Denoting this by M_e, then if the maximum tensile and compressive stresses due to a simple bending moment M_e are calculated, they are found to be equal in magnitude to the major principal stress due to the combined action of M and T. The maximum shear stress due to simple bending moment M_e is not, however, the same as that due to M and T combined. If it is only the maximum tensile or compressive stress that is required, this point is of little importance, as the shear stress is not introduced into the calculation.

After describing the above expression as the "Equivalent Bending Moment," it is usual to proceed to refer to the expression

$$M + \sqrt{M^2 + T^2}$$

as the "Equivalent Twisting Moment," defining this as the simple twisting moment which, if acting alone, will produce principal stresses (equal and opposite) each equal to the *major* principal stress due to M and T combined.

As a means of determining maximum tensions and compressions this leads to exactly the same result as the "Equivalent Bending Moment," and there would therefore appear little occasion for its use in this manner. There is, however, a serious objection to it. Although any stress system is completely defined by the principal stresses, it is a particular shear stress, namely, that on normal transverse planes, which is usually associated with a twisting moment; the calculation of this shear stress is, indeed, the first step, implicit or explicit, in the determination of the principal stresses. With a simple twisting moment the principal stresses are equal numerically to the shear stress on this plane, and this is the argument underlying the use of $M + \sqrt{M^2 + T^2}$ as an "Equivalent Twisting Moment." The shear stress so calculated has, however, no relation whatever to the actual shear stress on any plane in the shaft, and any attempt to determine shear stresses in the usual manner from "Equivalent Twisting Moment," as above defined, will result in considerable error. If now the expression $\sqrt{M^2 + T^2}$ is regarded as "Equivalent Twisting Moment," the correct value of the maximum shear stress is obtained from the ordinary torsion formula, although it would not give the correct values of the maximum direct stresses.

With the object of reducing confusion and liability to error, I would suggest that, if these terms must be retained, their definition should be framed so as to indicate the stresses to which they refer, and with which they are most naturally associated. Bending moments are most naturally associated with direct stresses, and twisting moments with shear stresses, and design is usually based either on the maximum tensile or on the maximum shear stress. Accordingly "Equivalent Bending Moment" ought to be defined as that bending moment which, acting alone, would produce the same maximum tensile or compressive stress, the value being $\frac{1}{2}(M + \sqrt{M^2 + T^2})$. On the other hand, "Equivalent Twisting Moment" should be defined as that twisting moment which acting alone would produce the same maximum shear stress as M and T combined, its value being $\sqrt{M^2 + T^2}$.

By thus eliminating ambiguity and restricting their use, there is much less objection to such terms than is at present the case. GILBERT COOK.

Engineering Department,
King's College, London, W.C. 2,
February 15th.

Progress of the Sutlej Valley Project.

AN important addition to the irrigated area in the Punjab was made in October of last year, when his Excellency the Viceroy opened the Ferozepore headworks of the Sutlej Valley project, which have been constructed by the Punjab Irrigation Branch at a cost of nearly 180 lakhs of rupees, or £1,350,000. The works provide for irrigation on both sides of the river, as far as the eastern boundary of the Punjab, at Reti, a distance of 336 miles.

The weir at Ferozepore, which is the furthest upstream of the series of these works, is the second to be completed, the weir at Suleimanke having been opened in 1926. The Ferozepore weir has twenty middle spans of 60ft., five similar spans next the right bank and four next the left bank, forming "pockets" from which the canals take off. The total length of the weir is 1956ft., and it is designed to discharge 450,000 cusecs. All the spans have counterbalanced gates made by Messrs. Ransomes and Rapier. The three head regulators are provided with Walton gates made by the same firm.

Two canals take off on the left bank. The Bikaner Canal, the capacity of which is 2144 cusecs, will be perennial and will command 765,000 acres in Bikaner State. It is lined throughout its length with cement concrete. The Eastern Grey Canal, the capacity of which is 3320 cusecs, will command nearly 515,000 acres, of which about 250,000 acres can be irrigated annually. It will supply water during the hot months only.

The Dipalpur Canal, which takes off from the right bank, commands 1,095,000 acres, of which about 600,000 acres can be irrigated annually. Its capacity is 6950 cusecs.

The weir at Ferozepore is one of four in the Sutlej Valley project, the others, further downstream, being at Panjinad, Islampur, and Suleimanke. The last-named was completed in 1926, so that two of the four are now in operation. From those four headworks eleven canals will irrigate five million acres in the Punjab and in Bikaner and Baharwalpur States. The decision to build four weirs was based upon the advantages in having relatively short canals, and was the result of the discussion of a scheme put forward in 1917 by an executive engineer of the Irrigation Department. A proposal to build a weir and bridge across the Sutlej was made about the year 1854, by an officer of the Royal Engineers, during the preparation of the Bari Doab Canal project. This scheme was rejected as being too costly, but in 1866 Colonel Strachey, R.E., took up the subject and a plan was submitted as the Bari Doab project of 1872. This also was rejected on the score of cost, the cheaper method of irrigation by means of inundation canals being preferred. The latter were, however, so planned that they could form a part of a weir scheme. In 1897 the matter was again to the fore, but as a result of changes in policy following the recommendations of Lord Curzon's Irrigation Commission, nothing was done until 1915, in which year the opening of the Upper Jhelum Canal left the Punjab Irrigation Department free to turn its attention to the Sutlej and the Beas. After consideration had been given to various proposals, Mr. H. W. Nicholson was put on special duty and evolved the scheme which was eventually put into operation. Mr. Nicholson built the Suleimanke weir. His work received recognition at the opening of the Ferozepore headworks in October last, when he was invested by the Viceroy with the decoration of the C.I.E.

In respect of the area irrigated and the extent of waste lands brought under cultivation, the Sutlej Valley project will excel the Triple Canal project. The area affected is 9 million acres, and the total expenditure involved over 14 crores of rupees, or about 10½ millions sterling. The approximate contributions to that total are 7 crores by the State of Baharwalpur, five by the Indian Government and two by Bikaner State. Work began in October, 1922, and two of the four stages have been passed by the opening of the Suleimanke weir in 1926 and the Ferozepore weir last October.

MANCHESTER ASSOCIATION OF ENGINEERS.

A PAPER on "Inspection Methods" was read at a joint meeting of the Manchester Association of Engineers and the North-Western Section of the Institution of Electrical Engineers, at the Engineers' Club, Manchester, by Mr. E. J. Parish, on Friday, February 10th. In his paper the author confined inspection to its usual meaning in the engineering industry. He divided the processes of manufacture into three headings :—(1) The preparation of the specification; (2) the carrying out of the work; and (3) inspection. The decision as to the stages at which inspection should be carried out was of primary importance, for it was easily possible more than to offset the whole cost of inspection by doing it at a stage at which it might save a good deal of futile expenditure. The paper was subdivided into several sections, as follows :—Control of Inspection; Outline of an Inspection; System; Standards and gauges; Inspection stages; Raw material inspection; Inspection stages during manufacture; Heat treatment; and Inspection tools, such as micrometers, slip gauges, dial gauges, plug, snap, taper, form, vernier slide, optical and screw gauges; all of which were illustrated by lantern slides.

In considering the control of inspection in any manufacturing business, Mr. Parish said that they could be divided into two fundamental methods: First, the control of its own inspection by each individual department; and, secondly, the control by a centralised inspection authority. There was a case for control by the department when that department is self-contained, in which case it could be considered as a small factory in itself; but, even in that case, the inspector should only report directly to the head of the department, and should have a suitable status. Generally, he considered that the advantages lay with the method of control by a centralised inspection authority. In actual practice a combination of the two methods would generally be employed, the central authority controlling inspection in all works departments, but not in the drawing-office, selling or finance sections of the business, which departments would have their own internal inspection systems.

CUTTLEFISH CASTINGS.*

IN the course of a lecture that he delivered recently to the Woking Ironmongers' Assistants' Association, Mr. C. C. Hopkins, of Smith and Davis, Ltd., stamped brass-founders, of Birmingham, mentioned that an easy way to make small, single castings in brass was to use the cuttlefish method. At our request Mr. Hopkins has kindly written the following description of the process, which our readers will find exceedingly interesting.

Cuttlefish is a material that can be used for making moulds into which molten metals can be poured to produce small castings. Its usefulness lies in the fact that a casting mould suitable for the production of small metal articles, cored or plain, can be quickly made at a trifling cost and by unskilled labour.

Supposing, for example, one had a Yale key and wished to produce a replica of it, a simple method of doing the job would be by casting it in brass in a cuttlefish mould. In order to do this proceed as follows: Procure from a drug store a piece of cuttlefish about 7in. long. It may be obtained in all lengths from 3in. to 15in., but, of course, one selects a piece of a suitable size for casting whatever object one has in view. Note that the cuttlefish has a hard skin back, and a soft yielding surface at the front—this being the portion used for the mould.

Take the cuttlefish and with a saw cut it across into halves. Rub the soft surface of each piece on a brick until quite flat. Place the two flattened surfaces together, and see that each piece lies level upon the other. Pull apart and lay them on the bench with the soft surface upwards. Then take the key, of which you wish to produce a replica, and laying it flat on the surface of the cuttlefish, press it down until one-half of the thickness of the key is embedded, leaving the other half protruding. Take the other piece, and laying it in position upon the key, press it until the exposed half of the key is fixed in this portion of the mould. Now trim the rough edges at the top and side, rubbing them flat while the two pieces are together in order to get them both same size and shape.

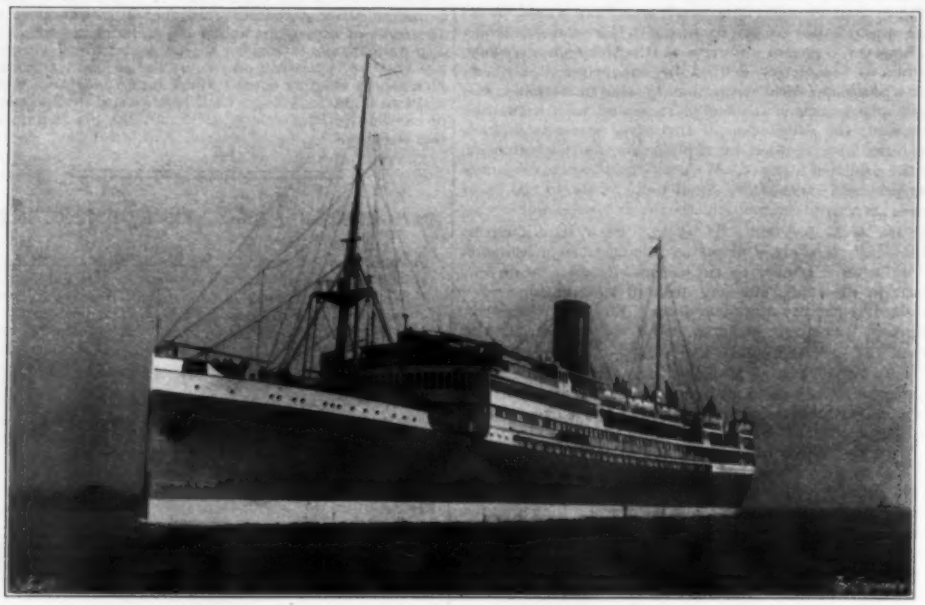
Pencil marks are made upon the sides for registering the mould, and a suitable "git" is cut with a penknife. No dressing of the mould is necessary.

A WELL-KNOWN mechanical engineer of Toronto—Mr. W. S. Haggas—died on January 24th, at the age of fifty-nine. Mr. Haggas designed and constructed some of the first internal combustion engines that were built in Canada, and was connected with several British engineering concerns. In 1922, for example, he was made chief Canadian representative for the Keighley Gas and Oil Engine Company of England. Two years later Mr. Haggas started in business for himself in Toronto with his son William T. Haggas under the name of Haggas-Keighley Oil Engine Company.

* *The Ironmonger*, January 28th, 1928.

THE ROTTERDAM LLOYD MOTOR LINER "SIBAJAK"

KONINKLIJKE MAATSCHAPPIJ "DE SCHELDE," FLUSHING, BUILDERS AND ENGINEERS



The Rotterdam Lloyd Motor Liner "Sibajak."

On Friday last, February 10th, we were afforded an opportunity of inspecting the new motor passenger liner "Sibajak," which was lately added to the fleet of the Rotterdam Lloyd Royal Mail Line, and called at Southampton, on her maiden voyage to Sourabaya. The new liner, a view of which is given in the accompanying engraving, is larger than her sister vessel, the "Indrapoera," and she is equipped with more powerful machinery, two eight-cylinder engines being installed, as against two six-cylinder engines in the earlier ship. It is interesting to note that, in the two new liners recently ordered by the company, twin-screw ten-cylinder engines are to be employed, marking a further increase in size and propelling power. The "Sibajak" was built and engined at the Royal de Schelde yards at Flushing, and her propelling motors are of the De Schelde-Sulzer two-stroke single-acting type, embodying some new features.

She has an overall length of 530ft. with a breadth of 62ft. 6in. and a depth of 38ft. Her loaded draught is approximately 27ft., and she has a gross tonnage of about 12,000, with a designed speed of 17 knots. Cabin accommodation is provided for close upon two hundred first-class passengers and about the same number of second-class passengers, with nearly seventy third-class and thirty-five fourth-class passengers. There are about 118 single and double-berth cabins, and several of these may be arranged in suites.

A distinctive feature of the public rooms, cabins and deck arrangements is the evident care which has been expended in producing a ship which will be specially suited for trading and carrying passengers in warm climates. The rooms are very lofty and ample ventilation is provided. There are large deck spaces for the various classes of passengers, and, as shown in our illustration, the first-class promenade deck is enclosed with windows at the forward end.

The deck machinery comprises Laurence Scott cargo winches, and this firm also provided the windlass motor, the boat-hoisting motors, steering gear motors, and the motors for the four electric cranes, which serve one of the main cargo hatches. The steering gear was built by Hasties and is of the Hele-Shaw electric hydraulic four-ram type, controlled from the bridge by telemotor gear. Among the navigating instruments we noted the Sperry gyro-compass, which is fitted with the automatic helmsman device.

A very extensive wireless equipment is carried, and also underwater signalling gear. Each of the main engines has a designed output of 5000 B.H.P. when running at a normal speed of 95 r.p.m. The cylinders are 760 mm. by 1340 mm. At the forward end of each engine are arranged the tandem air scavenge pumps and the three-stage injection air compressor. For the admission of the scavenge air to the cylinders automatic air valves in the scavenge air main are provided, but the air is furnished by the reciprocating tandem scavenge pumps driven from the main crank shaft. The diameter of the scavenge pump pistons is 1800 mm. and the stroke is 850 mm., which gives a swept volume of 1·78 times that of the working cylinders. About 1000 cubic metres of air have to be handled per minute by each pump, and this supply is taken through a divided intake, part being drawn from the engine-room to promote ventilation, while the main supply is taken through an air suction trunkway, carried up to the top deck, which delivers the air through two cylindrical vessels accommodated on an upper platform in the engine-room. These vessels are fitted with a series of large Venturi tubes, through which the air is made to pass on its way to the scavenge pumps. By this means a steady flow free from pulsation is obtained.

The main engines are fitted with electric turning gears, and the controls are arranged at bottom platform level at the centre of each engine. For the cylinder jackets salt cooling water is used, but the pistons are cooled with fresh water, and a modified arrangement of piston-cooling tubes, embodying a Venturi tube on the inlet side, which transforms the velocity of the jet into pressure, is fitted. This new arrangement was designed by the De Schelde Company and is now adopted for standard use. A further point of interest with regard to the main engines is the fitting of a centrifugal spark arrester in the main funnel, the object of which is to quench any incandescent particles of carbon in the exhaust gases which otherwise might pass out of the funnel unextinguished. This arrester was designed by Mr. S. G. Visker, of the Netherland Steamship Company, and comprises a cyclone attached to the exhaust uptake, in which the particles of carbon are consumed.

The auxiliaries are accommodated in the same room as the main engines, and it may be remarked that all the engines are painted green in colour, with the special pipe circuits picked out in other distinctive colours for the ready detection of any particular service. There are three main generator sets, each comprising a five-cylinder 650 B.H.P. De Schelde-Sulzer motor, with a cylinder bore of 380 mm. by 660 mm. stroke, designed to run at 170 r.p.m., and coupled direct to a 425 kW generator. Each set drives its own auxiliary service pumps. There is also a four-cylinder Sulzer airless injection set of 200 B.H.P. and 165 kW output and a 2 B.H.P. hot bulb engine-driven emergency compressor set. The complement of pumps is very complete, and the units are particularly well arranged along with the generator sets in the two engine-room wing spaces, and the space aft of the main engines. This large auxiliary engine equipment of 2100 B.H.P. total output is rendered necessary by the large number of electrically-operated auxiliaries and the electric heating appliances, which are installed throughout the ship. On the run from Holland to Southampton last week a measured mile trial was run, when a speed of 16·59 knots was made with the engines running at 89 r.p.m. and a mean loaded draught of 24ft.

The "Sibajak" and her machinery were built at the yard of the Royal De Schelde Shipbuilding and Engineering Company, of Flushing, in collaboration with the technical staff of the Rotterdam Lloyd Company, under the supervision of the company's superintendent engineer, Mr. R. C. Weidenaar.

It is of interest to learn that the two new ships recently ordered by the company will also be built at Flushing. They are to be named the "Baloeran" and "Dempo," and will have a length of about 573ft. 9in. with a beam of 70ft. and a depth of 44ft. The gross tonnage will be round about 16,000, and the designed output of the twin-screw De Schelde-Sulzer oil engines will be 14,000 S.H.P.

The arrangements to visit the "Sibajak" on Friday last were carried out through the London agents of the Rotterdam Lloyd Royal Mail Line, Escombe, McGrath and Co., of 13, Fenchurch-avenue.

LAUNCHES AND TRIAL TRIPS.

"CARTIERDOC," steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steam Ships, Ltd.; dimensions, 253ft. long. Engines, inverted marine type with three cranks; constructed by the builders; launch, January 23rd.

"CHRISTIAN HUYGENS," motor vessel; built by the Netherland Shipbuilding Company, to the order of Stoomvaart Maatschappy "Nederland;" dimensions, 570ft. by 68ft. 6in. by 39ft. 9in.; 15,637 gross tonnage. Engines, twin-screw Sulzer; constructed by Werkspoor, Amsterdam; trial trip, January 25th.

"KING NEPTUNE," motor vessel; built by Harland and Wolff, Ltd., to the order of The King Line, Ltd.; dimensions, 400ft. by 54ft. 6in. by 34ft. 8in.; 5180 gross tonnage. Engines, six-cylinder four-cycle single-acting Diesel; constructed by the builders; launch, January 26th.

"DEAL," twin-screw steamer; built by D. and W. Henderson and Co., Ltd.; to the order of the Southern Railway Company, Ltd.; dimensions, 230ft. by 33ft. 8in. by 15ft.; 680 gross tonnage. Engines, triple-expansion, 15in., 25in., 41in. diameter by 24in. stroke, pressure 200 lb.; constructed by the builders; launch February 10th.

"SCOTTISH CHIEF," steel screw steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Tankers Ltd.; dimensions, 440ft. by 56ft. 8in. by 33ft. 11in.; 10,000 tons deadweight. Engines, direct-acting, surface-condensing, quadruple-expansion, marine type, 24½in., 34½in., 50in., and 74in., with 54in. stroke; constructed by the builders; launch, February 7th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

ALTHOUGH merchants on 'Change in Birmingham to-day—Thursday—reported the receipt of a considerable number of inquiries there was no actual proof of an increase in the volume of business reaching the books of producers of iron and steel in the Midlands and Staffordshire. There are encouraging signs, however, which lead producers to believe that the present market dullness will be superseded in the near future by increased activity. Many local manufacturing industries report improving business, and their raw material requirements will increase as demand for their goods expands. In this connection much is expected from the British Industries Fair, which opens at Castle Bromwich next week, and at which a larger number of foreign buyers than ever before are expected. Iron and steel orders continue for the most part for small tonnages, no difficulty being experienced in obtaining early, if not immediate, deliveries. Values remain firm, with no changes of note on the week. Producers insist that prices are now at rock bottom. It is reported from the North that fuel values are advancing, and if the movement spreads to the Midlands there is a possibility of iron and steel values hardening. Iron and steel masters assert that they cannot possibly shoulder any increase in costs of production, and any advance in fuel charges will, they say, have to be passed on to the consumer of iron and steel.

Raw Iron.

Sales of pig iron do not appreciably improve. Generally speaking, orders are for small tonnages for immediate delivery, and furnaces have no difficulty in keeping pace with them. There has been no development of note in this department. Smelters continue their firm attitude with regard to prices, and consumers find themselves impelled to place orders at the quoted rates. Northamptonshire No. 3 foundry makes £3, forge £2 14s., Derbyshire foundry £3 4s. to £3 5s., forge £2 19s., all at furnaces. Forge iron is in no better request than of late, the Black Country forges being very short of work. There was some effort this week by coke oven men to advance prices, but up to the time of writing supplies are still obtainable at 12s. per ton, the figure lately ruling.

Steel.

The steel mills of the district are moderately engaged, though orders are mostly for small quantities. Consumers are content to order small supplies owing to the facility with which quick deliveries are made. Constructional engineers' purchases have improved slightly this week, and builders of rolling stock in the district have also taken increased quantities of material, while the more healthy condition in the plate mills, recently recorded, persists. Angles and joists sell only moderately at £7 12s. 6d. Tees are quoted £8 12s. 6d., ship, bridge and tank plates £8 7s. 6d., boiler plates £11. Small bars range from £7 7s. 6d. to £7 17s. 6d., and soft billets, obtainable at £6, have a tendency to stiffen in value. Staffordshire hoops are named £10 10s. at works. The higher range of prices lately applying to continental steel shows every indication of continuing. Sheet bars can now be bought from native mills on terms more favourable than the foreigners can offer if allowance be made for quality and delivery facilities. The strip makers also are getting on competitive terms. German billets are quoted £5 12s. for 2in. delivered here and blooms about £5 5s. The rise in foreign steel prices has certainly reduced the buying in this district, and Midland mills hope gradually to increase their sales of semi-finished material as the margin between home and foreign prices narrows.

Finished Iron.

While the improvement in the Staffordshire finished iron industry is maintained, the orders on the books are no more than will provide employment for a short time. There is a brisker demand for chain and cable iron due to the requirements of new shipbuilding enterprises. Nut and bolt makers are busier, but are utilising little native material. Tube works are fairly well engaged and are taking increased tonnages of gas strip. Marked bars continue to be quoted £12 10s. and Staffordshire Crown bars £10 5s. to £10 10s. The very low prices recently quoted for Crown bars of outside make are gradually disappearing, this week's minimum apparently being £9 7s. 6d., which is a further advance of half-a-crown. Belgian No. 3 iron is dearer, importers this week asking £6 4s. to £6 5s. per ton delivered. Staffordshire nut and bolt and fencing iron is still named £9. Wrought iron gas tube strip commands £11 10s. per ton.

Galvanised Sheets.

There is a moderate demand for 24-gauge galvanised corrugated sheets, values of which remain on the basis of £13 to £13 2s. 6d. for export and home consumption respectively. Thinner gauges are quiet at recent rates. The motor engineering industry is calling for rather larger supplies of black sheets.

Trade Returns.

When compared with the corresponding month of last year, the trading conditions as affecting the iron and steel industries give cause for considerable satisfaction, and such was this week expressed by Midland industrialists. They remark with pleasure upon the decrease of £2,014,689 in the imports of iron and steel and manufactures thereof. The total quantity imported during January was 283,921 tons, valued at £2,297,920, compared with 555,453 tons and £4,312,609 in the corresponding month of last year. The export returns are even more gratifying, again comparing them with the corresponding month of 1927. The feature of the month's exports was the advance over January, 1927, of £4,588,273 in articles

wholly or mainly manufactured, spread over trade generally. The increases included:—Machinery, £810,474; vehicles (including locomotives, ships and aircraft), £894,352; and iron and steel and manufactures thereof, £665,239. When compared with the previous month's trading, however, the statistics do not show up to such good advantage. Imports were slightly up, the figures for December being 283,921 tons, valued at £2,297,920.

Birmingham Exports to U.S.A.

In some important departments, notably in metal manufacture, exports from the Birmingham district to the United States of America last year showed a falling off. The aggregate value of all merchandise supplied to American customers was roughly £38,000 over the amount for the preceding year, when trade was notably in a bad way. While steel sashes contributed 303,202 dollars to the total, against 275,945 dollars, other manufactures of iron and steel declined from 503,335 dollars to 478,676 dollars. Brass goods dropped from 281,167 dollars to 220,497 dollars, and all other metal manufactures from 605,318 dollars to 398,033 dollars. Machinery and vehicles were slightly lower. The last quarter showed up more favourably than the corresponding period of 1926, but trade continued to be very irregular.

Production Figures.

The record of iron and steel production during the past month, although in each instance slightly in advance of the December figure, was below that of November. Output of pig iron was 560,500 tons, compared with 559,100 tons in December and 575,900 tons in November. The production included 190,000 tons of hematite, 198,600 tons of basic, 128,700 tons of foundry, and 23,200 tons of forge pig iron. The quantity of steel ingots and castings produced in January was 626,200 tons, compared with 604,900 tons in December and 698,700 tons in November. Taking into consideration the rate at which the number of furnaces in blast have been reduced for months past, it is some satisfaction to discover that during January there was a net decrease of only one in the number of active furnaces, nine furnaces having gone out of operation and eight having been put into blast.

Edge Tools.

The Midland heavy edge tool industry, which has been experiencing very quiet business for a lengthy period, is just now undergoing a slight improvement. There have been occasional spurts of short duration during the past months, but manufacturers are inclined to view the new movement in a more favourable light. In the first place, continental competition, which has been very severe for a long time, has a tendency to become less keen as a result of the rise in raw material prices and some reaction against German goods in certain quarters of the East. Secondly, the inquiries now being received come, not from one overseas market, but from many. The Eastern markets are circulating orders, Australian business is picking up again, South African inquiries are slightly better, but there is little business coming through from South America. Generally speaking, the feeling in the trade is moderately bright, and an improvement in orders in the near future is anticipated.

Improved Transport Facilities.

Midland iron and steel masters, engineers and manufacturers have this week been given to understand that the Chambers of Commerce of many towns in the Midlands and in the Liverpool area, as well as other representative bodies, have been invited to send delegates to a private meeting to be held at Stoke-on-Trent in the near future, with a view to discussing the possibility of improving the facilities for the rapid transport of goods between the Midlands and the Merseyside. Such facilities, it is understood, would entail provision of a road to be used exclusively for motor traffic and constructed entirely by private enterprise. Details are not yet available, but the names of those associated with the project would not be unfamiliar in the Midlands and the Northern cities, and the interest displayed by the public bodies concerned indicates that the scheme is one which should commend itself to industrialists for consideration.

Coal Marketing Scheme.

Since I last wrote there have been new developments in the Cannock Chase coalfield with regard to the proposal that that district should join the Yorkshire, Derbyshire, and Nottinghamshire coal marketing scheme. Representatives from Cannock Chase area have met representatives of the three counties mentioned to discuss the position. Coalowners from North and South Staffs., Warwickshire and Leicestershire have also taken part in the negotiations, so that Cannock Chase cannot afford to be outside the operation of the scheme if the other adjoining coalfields are going to be a part of it. Trade conditions are so bad and prospects so far from satisfactory or encouraging that many of the local coalowners feel that something drastic will have to be done if the coal industry is to recover its former prosperity. Their contention at the moment appears to be that the marketing scheme cannot very well make things worse than they are at present. It is realised that Cannock Chase cannot much longer defer its definite decision if it is to participate in the scheme from the commencement. Though at one time there were many coalowners in this area who were opposed to the scheme, it is considered that the trend of events has resulted in a change of attitude and that Cannock Chase will, like Lancashire, probably join the other Midland coalfields.

Pit to Close.

The present depressed state of the coal trade, which is unprecedented at this time of the year in the Cannock Chase coalfield, is given by the West Cannock Colliery Company as the reason for the permanent closing down of its No. 4 pit. The 700 employees have been given notice, and while the colliery owners express their intention of doing everything possible to find employment for the men at other pits, it is felt that many will be left without work. The No. 4 pit was opened about fifty years ago.

B.I.F.

The Birmingham section of the British Industries Fair, which opens at Castle Bromwich next week, gives every sign of being a greater success than ever before. Every department of the heavy section shows developments even over last year, which was a record both for size and business done. The electrical group is half as large again as last year, while the general engineering and machinery departments number most of the leading firms amongst their exhibitors. Trade visitors from no fewer than forty-eight countries abroad will augment the many thousands of home buyers attending this section of the Fair.

Unemployment.

A slight set-back has to be recorded in the labour position in the Midlands area. For some weeks now the numbers of unemployed have steadily decreased, and it is unfortunate that the latest return should show an increase of nearly 2000. It is almost entirely due, however, to the number of temporarily suspended employees. The decline was spread over many local districts, Birmingham being responsible for the largest individual figure, one of 470. The total for the Midland area now stands at 141,308, of whom 52,202 are temporarily out of employment.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Electricity Plant for Stockport: A New Development.

A NEW and interesting situation has arisen in connection with the Stockport Corporation's call for tenders for the supply of electricity plant, a matter which was referred to in this column a week ago, when it was announced that the Corporation had accepted a Swiss tender of £34,307 for a 20,000-kW turbine set, the lowest tender received form a British firm being £52,000. In the meantime, the Stockport Corporation has disclosed the fact that it has since received an offer from a British engineering firm to supply the plant in question for the sum of £42,000. The contract with the Swiss firm has not yet been signed, and it is expected that a special meeting of the Town Council will be convened for the purpose of considering the new offer. In the course of an interview, the chairman of the Electricity Committee, Councillor J. Morton, said that to some extent the new offer created an altered situation which would have to be dealt with by the Council. Whilst, personally, he had always been in favour of the order being kept in this country, the difference in prices between the British and the foreign tenders was too great.

Co-operation and Amalgamation.

The Lancashire and Cheshire Coalowners' Association has now decided to participate in the co-operative coal-marketing scheme which has been adopted by Yorkshire, Nottinghamshire and Derbyshire, and the decision has been referred to the various colliery companies for confirmation. Meanwhile, although nothing tangible has been made public, rumours have been circulating during the past few days of a movement among several important Lancashire colliery companies, with a view to amalgamation. Whilst on the subject of the Lancashire coal industry, it may be of interest to record the following quotation from the annual report of the Wigan Coal and Iron Company, Ltd., which has just been issued:—"Two collieries, having reached the end of their useful life, have been closed. The remainder of the pits have been maintained in efficient and safe working order, and, despite decreased output, the cost of production has improved. The steel works have only worked intermittently, and it was found necessary to suspend melting operations in October. After the spurt given to the iron and steel trade by the accumulation of orders following upon the 1926 stoppage, the company again had to face keen foreign competition; orders declined and prices fell heavily."

The Electricity Scheme.

On behalf of the Central Electricity Board, Mr. A. Kennedy arrived in Manchester at the beginning of this week to commence a tour of inspection of the electricity generating stations in Manchester, Salford, Liverpool and other parts of Lancashire, Yorkshire and Westmorland, with a view to the elimination of out-of-date stations. It is expected that the Electricity Commissioners will visit Manchester in June or July to arrange an electricity scheme for Lancashire and the North-Western area. Alderman W. Walker (Manchester), who is chairman of the National Joint Board for the Electricity Supply Industry and a member of the Central Electricity Board, speaking at the annual dinner in Manchester last Saturday of the Northern Division of the Electrical Power Engineers' Association, said that some of them might be expecting unfavourable results from the operation of the Electricity Act of 1926. Under the Act there would be concentration—fewer generating stations with greater capacity—but when they recollected that that would result in the greater efficiency of the industry and the employment of a larger number of people within it, they would see that the fears originally entertained were groundless. The process of closing down the unwanted stations would be very gradual, and would be carried out with the minimum of inconvenience to all concerned.

Works Extensions.

It is announced that John Hetherington and Sons, Ltd., the Manchester textile machinists, are extending their Vulcan Works foundry, so as to increase its capacity by 50 per cent. During the last few years Messrs. Hetherington have branched out very considerably into the manufacture of artificial silk machinery, and the equipment for some of the largest artificial silk mills in the country has been made in the firm's shops.

Non-ferrous Metals.

The tin section of the non-ferrous metal market has been even more erratic during the past week than before, even though the net loss has been not quite so serious as in the previous week. So far, the lower prices have brought out little improvement in the demand for the metal, though it is extremely likely that, before long, buyers will be unable to resist coming into the market for substantially increased quantities at the present relatively favourable figures. Signs of this were apparent at one period, when United States interests accelerated buying operations, with a consequent upward reaction in quotations, but the increased demand as quickly died away, and the improvement in values was short-lived, cash metal closing at the moment of writing about £7 a ton lower than a week ago, the decline during the past two weeks amounting to rather more than £16 a ton. In the case of copper prices weakened at one time on a continued poor demand, but there has since been a recovery from the worst, and current quotations are only fractionally lower than they were a week ago. Lead buying has been relatively slow, and there has been a somewhat pronounced drop in prices, offers of the metal being on a fairly liberal scale. The demand for spelter has only been on moderate lines, but in this case available supplies have not been excessive, and the loss on the week has amounted to no more than about 2s. 6d. a ton.

Iron.

Perhaps the only favourable feature about the iron market here is the fact that there has been no further general weakening of the price position, although it is still possible on occasion to hear of figures for the delivery of Midland foundry irons to Lancashire towns at several shillings a ton below the level to which quotations for these classes of iron have fallen. It is fair to point out, however, that instances of this nature are by no means numerous, and, what there are, are obviously cases in which holders of the metal are forced, through financial pressure, to realise. Nevertheless, such transactions exercise an effect on the general market, out of all proportion to their individual significance and under the circumstances it is a matter of considerable difficulty for makers to maintain prices, particularly in view of the unsatisfactory state of the demand. For delivery into this area, Staffordshire No. 3 is quoted at about 71s. 6d., with Derbyshire at 72s. to 72s. 6d., Middlesbrough at 78s. 2d., Scottish from 87s. 6d. to 88s., and West Coast hematite at about 84s. 6d. So far as bar iron is concerned, there is not much stirring here, although prices are held at £10 per ton for Lancashire Crown bars and £9 10s. for second quality material.

Steel.

The principal feature of interest in the steel market during the past week has been the attempt on the part of some of the Lancashire re-rollers to secure a price for small diameter bars consonant with the higher prices which continental steel works are now asking for billets. Apart from the fact that the demand for these bars is quiet, as it has been for some time, it is doubtful whether the firms in question have been very successful in getting the £7 15s. which they are now asking, for values in this section of the market during the week have displayed considerable variation. So much may be judged from the fact that one firm this week offered bars freely at £7 10s., and another—a stockholder—complained that he had missed an order at £7 7s. 6d. There has been some small buying of boiler plates at £9 15s. to £10 per ton for basic plates and about 5s. more for acid sorts. Joists and sections at £7 12s. 6d. and general plates at £8 7s. 6d. are unchanged in price, and are moving off in moderate quantities for early delivery. With regard to imported steel, both inquiry and actual demand have been on a restricted scale, but quotations in most sections of the market are firmer at about £5 5s. per ton for billets, £5 7s. 6d. to £5 10s. for sheet bars, £5 15s. for joists, £7 5s. for Thomas plates, £7 12s. 6d. to £7 15s. for Siemens plates, £6 7s. 6d. for steel bars and angles, and £6 5s. for Belgian bar iron, for net cash against documents, and including delivery to buyers' works in the Lancashire district.

Institution of Civil Engineers.

The seventh annual dinner of the Manchester and District Association of the Institution of Civil Engineers was held at the Midland Hotel, Manchester, on Thursday, 9th inst. Mr. Daniel Adamson, chairman of the Association, presided, and there was an average attendance which included Mr. E. F. C. Trench, President of the Institution; the Lord Mayor of Manchester; and the Mayor of Salford. The toast of "The Institution of Civil Engineers" was proposed, as is customary, by a student, Mr. W. H. G. Mercer, assistant Honorary Secretary of the Association. The President, who replied, said that the Manchester Association was one of the most successful, if not the most successful, of the Institution's Associations. He referred to the benefits which had been conferred on Manchester by engineers, and said that the construction of the Ship Canal was one of the most romantic events in engineering. Engineers, he said, had been passing through a "thin time," but it was hoped that a trade revival would soon develop and provide more work for them all. In visiting several of the engineering colleges recently, he was told, Mr. Trench continued, that there was no difficulty in placing the students in work of a suitable kind, which seemed a hopeful sign. The toast of "The Manchester and District Association" was proposed by Sir Cyril Kirkpatrick, member of Council, and was responded to by Mr. Adamson, who said that there was a quick response by the Councils of the learned institutions to suggestions which emanated from the provincial associations if a good case was made out. During the present session, he added, there had been a very good attendance of students at the local meetings. He paid a tribute to Mr. A. C. Dean, the honorary secretary, for his excellent work in promoting the welfare of the Association. The toast of "The Guests" was proposed by Colonel J. A. Saner, M. Inst. C.E., and

responded to by Colonel E. N. Stockley, D.S.O., chief engineer of the Western Command, who made an appeal to the younger members for support of the Royal Engineers.

BARROW-IN-FURNESS.

Hematite.

There is little left in the hematite pig iron market, and the amount of business being done is not by any means large. A few weeks ago it was hoped that the end of the quietness was in sight, and that trade would improve. This hope was encouraged to a slight extent by inquiries, but increased business did not follow. Stocks at works which are closed down are being reduced, but not quickly. There are stocks at other works which are producing, but fortunately in two places, Workington and Barrow, the steel departments are taking a considerable amount of iron, and this is helping to keep the present number of furnaces in blast. Trade with the Continent is quiet, and American business does not amount to much now. The best customers are Scotland and the Midlands, but their tonnage is not as large as one could wish. The iron ore trade is moderate, and will continue on the same lines until the demand for iron causes more furnaces to be put in blast. The amount going out of the district is not great. The steel market is quiet, and although both Barrow and Workington have orders on hand that will keep them going for some weeks, fresh orders would be very welcome for their continuous running after Easter. This applies to rails, &c. As regards the hoop mills at Barrow, they are well fixed.

Shipbuilding.

The order which Vickers-Armstrongs have received from the Admiralty for four submarines of the "P" class is very welcome. It is some time since the two Australian submarines, which left England last week for the Antipodes, were completed at Barrow and handed over. There is a feeling of optimism in Barrow as regards the shipbuilding and engineering prospects, but official statements as to further new contracts are at present lacking.

SHEFFIELD.

(*From our own Correspondent.*)

Heavy Steel.

THAT side of the steel trade which ranks as one of the country's basic industries—the production of ordinary classes of open-hearth steel for various commercial purposes—continues very depressed. Conditions have been bad all through this year, and there is no sign of improvement. It is hoped, however, that prospects may grow brighter before long, the hope being based on the fact that continental steel prices have risen, because of higher wages and shorter hours, while British quotations are now very low. A rather better inquiry for the raw materials of steel making is noticeable, but the amount of forward contracting remains poor, and it is difficult to dispose of the output of the blast-furnaces.

Manufacturing and Lighter Sides.

In these departments conditions are better, and movements, although slow, appear to be in the right direction. The placing of the contracts for underwater craft for the British submarine service, announced last week, is of interest to Sheffield. The new Vickers-Armstrong combine has received orders for four of these vessels, and although they will, of course, be built on the coast, Sheffield should derive benefit directly or indirectly. Another order, for one boat, goes to Cammell, Laird and Co., Ltd., who will thus resume the building of submarines for the first time since the war. It is also reported that Cammells are to carry out extensive repairs to the Anglo-American Oil Company's tanker "Seminole." The shipyards throughout the country are taking increasing quantities of Sheffield tools and other products, and engineers are also giving out larger orders, but the textile trades are not good customers. The demand generally for tool steel and tools is on a moderate scale, with prospect of improvement as the year progresses. The departments concerned with stainless steel and other special products continue to be among the busiest in the city.

Steel Combine's Difficulties.

The big combine known as the United Steel Companies has had a very unsatisfactory experience during the last few years, and in order to meet its financial difficulties it is about to promulgate a scheme the details of which will be issued shortly. In the meantime the secretary sent out a statement last week with reference to the issue of £1,016,300 unsecured 6 per cent. obligations which fall due for payment on April 19th next. In this statement it is pointed out that continued depression in the coal, iron and steel trades, coupled with the labour troubles of recent years, has had the effect of seriously depleting the company's working capital, and it is not practicable, in the present circumstances, for the company to raise the amount required to redeem the obligation issue at maturity. The board is of opinion that the time is not opportune to undertake a reorganisation of the company's share and loan capital. Given better conditions in the industry, the company's undertaking would be able to achieve a considerable measure of prosperity. With this end in view, and in order to protect the company's various interests until better conditions arrive, the board will shortly submit to the holders of the various classes of loan capital and the preference shares of United Strip and Bar Mills, Ltd.—the dividend on which is guaranteed by the company—a scheme which, while preserving the rights of the various parties, will give the company a measure of relief to enable it to meet the present difficult conditions. The circular adds that the dividend due on the preference shares of United Strip and Bar Mills, Ltd., on March 1st, will not be paid, but will be dealt with in the proposed scheme, which will be circulated before the end of the present month.

More Dismantling.

Thos. W. Ward, Ltd., of Sheffield, has purchased for dismantling purposes the blast-furnaces at Netherton, formerly belonging to Baldwins, Ltd. There are two blast-furnaces with the necessary Cowper stoves and blowing engines. One of the blowing engines is a turbo-blower of the latest type, with a capacity of 30,000 cubic feet of air per minute, and was installed only a few years ago. Both the furnaces have been out of blast for some time, and the dismantling operations are to commence immediately.

A Gift to the Cutlers' Company.

In recognition of hospitality extended to their Masters and Prime Wardens for many years, twelve of the great companies of the City of London are to make a presentation of pieces of plate to the Cutlers' Company of Sheffield. The plate will comprise a large salver, rose-water dish, large rose bowl and four smaller pieces.

Colliery Matters.

Colliery development in Nottinghamshire has been furthered by the striking of the High Hazel seam at the new Thoresby Pit, which the Bolsover Colliery Company is sinking at Edwinstowe, on the edge of Sherwood Forest. The coal has been found at a depth of 460 yards, which is much less than was anticipated. Sinking is being continued to the deep hard seam, and if that is found, as anticipated, at a further depth of 70 yards, it will be 80 yards nearer the surface than was calculated. The operations will probably last another four months. As previously reported, the colliery company is avoiding, as far as possible, interference with the amenities of the Forest. Smoky chimneys are being obviated by the introduction of electric winding, the power for which is supplied from the company's other pits at Bolsover, Creswell, Mansfield, Clipstone and Rufford. A colliery item of a less satisfactory character comes from Clowne, near Chesterfield, where the Staveley Coal and Iron Company has definitely decided to close down its Barlborough Colliery, owing to bad trade coupled with the fact that the top hard seam has become exhausted. The closing is expected to become complete in about six months, and the men will be gradually transferred to other pits belonging to the company.

A Notts. Railway Link.

The London, Midland and Scottish Railway Company proposes to construct a junction line at Farnsfield to connect the Mansfield and Southwell Railway of the company with the Mid-Nottinghamshire Joint Railways at Bilsthorpe. The length of the line will be 1 mile 2 furlongs 5 chains, and the engineers' estimate of the cost of construction as a single line is £53,850.

Sheffield's Trade Name.

The Sheffield Advisory Committee, in its sixteenth annual report, again records useful work done for the protection of Sheffield's trade name against unfair use. Negotiations with two individuals outside Sheffield to eliminate the word "Sheffield" from the title of their firm were successful. A company in the United States had lodged an application for registration in China of a trade mark consisting of the device of a bird accompanied by the words "Celebrated Sheffield Spring Steel, made in U.S.A." in respect of various kinds of tools. It was not possible to lodge effective opposition under the Chinese trade mark law, but representations were made to the Federal Trade Commission, and a letter has been received from the Board of Trade stating that the American company was taking steps to eliminate the word "Sheffield" from its trade mark.

Public Works.

The West Riding County Council is contemplating improvement schemes on main roads and bridges, during this year, involving an expenditure of no less than £964,000. Bradford Corporation is promoting a Bill for the improvement of its tram and omnibus systems, under which it is proposed to spend £127,336.

Brigg Beet Factory.

A sugar beet factory to deal with 700 tons of beet sugar per day is to be erected at Brigg, at a cost of £300,000. Sir Robert MacAlpine and Sons has obtained the contract, in conjunction with the Dyer Company, Ltd., of New York.

NORTH OF ENGLAND.

(*From our own Correspondent.*)

Coal Miners' Wages.

THERE is considerable disappointment among the miners in the Northumberland and Durham coalfields regarding the awards of the arbitrators on wages for the next three months. In Northumberland the percentage on basis wages was in the past twelve months 80; the arbitrator has reduced it to 40, which means about 2s. per shift to most of the men. At the same time, the 40 per cent. is 18 per cent. above the economic yield of the coal, as shown by the last ascertainment, but it does appreciably lessen the losses of the collieries, and will enable a good many of the pits to carry on, which otherwise would have had to close. So far as the Durham coalfield is concerned, the award does not bear upon the miners so severely as that under which their fellow-workers in Northumberland are called upon to work. The arbitrator has decided that the minimum percentage addition to basis rates shall be 65 instead of 89, as at present, and that the subsistence wage shall be 6s. 6½d. per shift instead of 6s. 8½d. Thus to the extent of 16 points Durham has fared better than Northumberland in the arbitrations. The result of the Durham award—which takes effect as from March 1st—is that coal hewers' wages will be reduced about 1s. 2d. per shift and other wages will be reduced in proportion. Hewers who earn about 10s. per shift, will thus be reduced to 8s. 10d. The county average is below 10s. Married men have the advantage, however, of free house or rent allowance and free fire coal. The owners have not got all they asked for, but the reduction is considered to be a workable one, inasmuch as it assists uneconomic conditions to a better level, and does not depress wages to a degree that is calculated to lessen production. If there had not been help through the award, many collieries might have been driven out of operation. As it is, there are many more pits and miners idle in Durham than in Northumberland. At the last ascertainment of proceeds and costs in Durham, the figures provided for 38·39 per cent. on basis wages, and on a minimum of 89 that left the owners to make up a deficiency of 50·61 per cent. The figure was low, but not so bad as in Northumberland, which recorded 22·94 per cent.

Prices and Speculators.

As the result of the arbitration awards, the Northern coal trade situation now bristles with difficulties, and already there has been a disturbing effect on foreign trade. Consumers naturally are waiting to see if the reductions in wages will bring any reductions in coal prices. The collieries are firmly trying to avoid any concessions, and if they can maintain present values, they will get the benefit of the arbitrators' findings, and at the same time stabilise prices for the three months of the award's duration. Speculators may no doubt cut prices to get business abroad, and rumour has it that they are doing so already. Nothing could be worse for all concerned at this time. If the collieries keep unitedly firm at present prices, the speculator will soon realise where he will be with his cheap contracts, and the rash price-cutting will stop. Moreover, it would be most unfair to the miners, who are making so great a sacrifice, for the reduction in their wages to afford lower-priced coal to the foreigner. Prices on the Continent are tending to rise, and there is every incentive to steady prices in Northumberland and Durham.

Cleveland Iron Trade.

Owing to mishap to a furnace at the Redcar Ironworks of Dorman, Long and Co., the number of blast-furnaces in operation on the North-East Coast has been temporarily reduced from forty to thirty-nine. As a consequence, supplies already falling short of demand have been further reduced, and extra calls made upon the ever-diminishing stocks available. The general improvement in business is maintained, and the outlook encouraging, though a somewhat unsatisfactory feature is the continued small margin of profit that current rates yield to producers. Most manufacturers have now fairly good order books, and confidence in further gradual expansion of transactions is pronounced. Home consumers have bought extensively for early and forward delivery, and some of them are still anxious to arrange contracts for supplies over periods ahead at round about current quotations. Values of Cleveland pig iron are very firm. Makers have not a great deal to offer in the open market after they have made provision for their own consuming plant, and little expansion of demand is needed to create a shortage. The strong statistical situation and the reports that continental ironmasters have little iron to dispose of, encourage Cleveland producers to hope that prices may move up a little in the near future. No. 1 Cleveland foundry iron is 67s. 6d.; No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; and No. 4 forge, 63s. 6d.

Hematite Pig Iron.

The situation in the East Coast hematite pig iron trade is improving, but supply is still more than ample, and producers continue to accept orders at well below cost of output. There is, however, just a little more business passing on both home and continental account. Sales are chiefly of iron made to special analysis to suit the particular purpose of the purchaser, ordinary brands being in very little request. The quotation of 70s. for mixed numbers still rules recognised market rates.

Ironmaking Materials.

The strike of ore miners in Sweden is expected to be felt much sooner by firms abroad who use that commodity than by consumers here, all of whom have good stocks and are in a position, in case of need, to substitute Lincolnshire ore for the imported material. Sellers take a firm stand, though they admit that, not only is new business difficult to put through, but some customers are disinclined to receive full deliveries against running contracts. Best Rubio ore is fully 21s. c.i.f. Tees. There is a marked upward movement in blast-furnace coke. Consumers, however, are very disinclined to follow the rise, but quite 18s. has now to be paid for good average qualities delivered to works in this area, and some sellers hold out for a higher figure.

Manufactured Iron and Steel.

Activity is still the keynote of the manufactured iron and steel trade. Output of manufactured iron is on a good scale, and fairly substantial inquiries are circulating for home trade. As regards finished steel, expansion of business is not altogether confined to home transactions, but export sales have to be made at keenly cut prices. Continental semi-finished steel is still being bought on a good scale, notwithstanding advance in prices. In no instance are quotations for products in this district changed, although the cessation or restriction of continental output as possibilities of the near future have to be taken into account.

Steel Rebate Scheme.

It was officially announced on the Cleveland iron and steel market on Wednesday that the heavy steel makers have advanced the price of steel plates, sections and joists for home deliveries by 5s. per ton on and after February 15th. The makers, parties to the rebate scheme, in order further to encourage the use of British steel, have

increased the rebate on material for home consumers by 5s. per ton from and including February 15th, on deliveries against contracts entered into or orders placed on and after that date. On such the rebate will be 10s. per ton on plates and sections and 12s. 6d. on joists. In effect it will be seen there is no alteration in price to those who participate in the rebate scheme.

The Coal Market.

The Northern coal market has a very quiet appearance. Inquiry is small from all quarters, and there are signs that competition abroad is as keen as ever. Operators are inclined to hold off to allow the new basis time to be assimilated. Meantime, there is a large available supply of coals on offer, and to tempt quick clearance holders are willing to accept discount prices. Actual business, however, remains on a very meagre scale. Direct sellers of best Northumberland steams ask 13s. 9d., but they can be bought in second hands down to 13s. Tyne primes can be similarly shaded from the nominal figures of 12s. 9d. to 13s., and seconds from 11s. 9d. to 12s. Steam smalls are abundant at from 7s. 6d. to 9s. for seconds and bests, and up to 10s. for specials. Durham steams are quiet at about 15s. for large and 11s. to 11s. 6d. for smalls. Gas coals are steadier than steams and keep to 15s. 3d. to 15s. 6d. for bests and 15s. 6d. to 16s. for specials. Coking fuel is making a better show at 13s. 3d. to 13s. 9d., and best bunkers are unchanged at 14s. to 15s., while seconds command 13s. 3d. to 13s. 6d. A quieter tone also prevails in the coke trade. Gas coke is scarce for this month, but the few parcels available are slightly easier in value, owing to lack of new business, and from 22s. 6d. to 23s. is indicated. Patent oven cokes are more plentiful, and some grades easier at 18s. to 19s. Beehive coke and also special makes are steady at 24s. to 26s.

Shipbuilding.

Sir W. G. Armstrong, Whitworth and Co. have received an order for a 7250 tons deadweight oil tank steamer for the Vacuum Oil Company, London. The ship will be built at the Low Walker Yard, and the engines at the firm's marine engine department, Scotswood. The firm has at present in its yards a large programme of work in hand, which includes, in addition to the order referred to above, nine oil tankers, five cargo boats, survey and buoyage vessel for Nigeria, two lake steamers, a floating dock and six dock gates for the Port of London Authority, Tilbury Dock.

SCOTLAND.

(From our own Correspondent.)

Scottish Miners' Wages.

THE accountants acting for the Scottish Coalowners' Association and the National Union of Scottish Mineworkers under the wages agreement have issued their joint reports on ascertainments of realised coal prices for December. These reports show the total proceeds from coal produced during December, and based on realised pithead prices, were £1,777,673, giving an average of 11s. 3·03d. per ton, or almost 5d. more than in November. The graded deficiency under the agreement since last March now totals £2,530,823. The miners' wages in Scotland will continue at the nominal minimum of 8s. 4½d. until the end of this month.

Steel.

There is no change in the position of the steel trade. Outputs are fairly steady, but very undersized, and would require to reach a much larger scale before conditions could be termed satisfactory. Few works are able to accumulate tonnage further than a week or two ahead. The plate and sectional mills are rarely employed at full capacity. Foreign competition is less keen, and the rising tendency of continental prices is viewed with a measure of satisfaction, although there is still a considerable difference between home and foreign prices of some materials. Steel sheets are not particularly active, but bear signs of improvement. Steel bars may harden somewhat in price, as continental semi-finished material is dearer. Heavy sheets remain quiet, and galvanised descriptions are not too busy, despite recent reductions in prices. All quotations are unchanged since last week.

Iron.

The bar iron trade continues in a subdued state, and the re-rolled steel bar section also is inactive. Home prices are unchanged at £10 5s. per ton bar iron and £7 15s. re-rolled steel bars, but export orders for either could be placed somewhat under those figures.

Pig Iron.

Scotch pig iron is in poor demand, Only twenty-five furnaces are in blast, but stocks in makers' yards continue to accumulate. Prices remain at recent levels, which some producers regard as barely remunerative. Shipments last week amounted to 1182 tons, of which 1010 tons went overseas.

Exports and Imports.

During the past week 15,900 tons of iron ore and 3800 tons of steel and iron were discharged at Glasgow harbour. Exports included 3700 tons of steel and iron and fair quantities of machinery, structural material, and tubes.

Scrap.

Scrap material is firm generally, and sales are somewhat brisker. Heavy steel is quoted 62s. 6d. and heavy basic about 57s. 6d. per ton.

Coal.

The position in the Scottish coal trade is practically unchanged. The production continues on a reduced scale, but supplies are ample to meet all demands, and the tendency in prices for shipment continues lower. The exception is still provided by Lanarkshire splints, the best qualities of which are fully booked until the end of February. Shippers are not disposed to discount colliery prices to consumers abroad, and business largely consists of the covering of small sales, but collieries are now more ready to consider price arrangements for prompt orders. Aggregate shipments amounted to 254,419 tons, against 188,364 tons in the preceding week and 282,960 tons in the same week last year. The home market is dull generally.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE records show that for the week ending the 10th inst. the quantity of coal shipped from South Wales ports came to just over 405,000 tons, which was about three thousand tons better than the preceding week. It appears to be very difficult to get above these figures, which represent approximately half the output of this district. The quantity is certainly insufficient to put any life into the market, which displays comparative dullness all round. As a matter of fact, it was scarcely expected that the total exports for last week would come up to the average, for the reason that the conditions on the market were described in all quarters as about the worst on record. Certainly the general inquiry for supplies of coal was meagre in the extreme, but there is a possible explanation, inasmuch as the probability is that more business is now fixed by the big combines than was ever the case, with the result that less of it is heard on the market. The small men are undoubtedly feeling the effects of the big combines more to-day than was formerly the case. To all outward appearances the conditions are bad, but that is not to say that shipments are not being fairly well maintained on the whole. Tonnage is not turning up quite as promptly as many collieries could desire owing to the severe weather, and this is, of course, causing trouble for many undertakings. At the end of last week there were as many as 46 idle loading berths at local ports, and the arrivals of tonnage over last week-end were disappointing, as on Monday last the total of idle loading appliances was 36. So far as forward inquiries are concerned, it may be mentioned that in the case of the Portuguese State Railways, which cancelled the tenders recently sent in for 100,000 tons of small coals, they have not yet made it known when new tenders are to be submitted. The French Marine is inquiring for 110,000 tons of best large coal or patent fuel for delivery at various French ports from March to the end of the year, but no great hopes are entertained that this order will come to this district. It is rather feared that it will go to French producers. The Algerian Railways have also asked for prices for 10,000 tons of patent fuel for delivery during March and April. Further news has now been received respecting the inquiry from the Egyptian State Railways. It is for 340,000 metric tons of locomotive large coals for delivery from April to the end of September, the quantities being: April, 30,000 tons; May, 65,000 tons; June, 65,000 tons; July, 65,000 tons; August, 60,000 tons; and September, 55,000 tons. The tenders have to be in at Cairo on March 6th. It was thought at one time that the railways might purchase quantities of about 100,000 tons for delivery over short periods, as they have done during the past year or so, but apparently they intend to buy the whole quantity for the full period of six months.

Docks Items.

At the end of last week an official announcement was made to the effect that no agreement had yet been come to between the Great Western Railway Company and the South Wales Chambers of Commerce on the question of inter-docking facilities, but that a statement would be issued as soon as a definite agreement was arrived at. This statement was issued because some persons had circulated information that the negotiations had come to a satisfactory termination. What can be said is that the negotiations have gone along very well and are likely to end in an agreement, but it is premature to say that an agreement is a *fait accompli*. With regard to the question of paying for waiting time, the secretary of the Cardiff Chamber of Commerce has issued to the members a circular informing them that as the result of a conference between the representatives of the South Wales Chambers of Commerce and the Great Western Dock authorities an arrangement has been made whereby, for a period of six months, the traders will not be subject to any demands for waiting time payments. During that period records will be kept of the waiting time incurred and of the circumstances and parties responsible for the delays necessitating such waits. At the end of the six months the whole question will be reviewed in the light of the experience gained. It is, therefore, important that all parties should give the utmost attention to matters that will facilitate the readiness and loading of steamers.

Tin-plate Trade.

The question of the *ex gratia* bonus which the employers last week decided to discontinue so far as the higher paid men are concerned, though continuing it to the lower paid men for another three months, was brought up at a meeting of the Standing Joint Committee of the South Wales Tin-plate Industry at Swansea on Monday by the workmen's representatives, who laid emphasis on the hardship which such decision involved. They also pointed out that, coming at a time when a better understanding than ever between the two sides was being arrived at, it might have unfortunate consequences. The employers, however, were unable to alter their decision, but they eventually agreed to the men's request to submit the matter to a special meeting of the Joint Industrial Council which is convened for Friday of this week.

Docks Statistics.

Great Western Railway Company statistics relating to the trade of the six ports in this district under its control show that for the four weeks ended January 22nd imports came to 359,629 tons and exports to 2,006,001 tons. The total of imports and exports from January 1st to 22nd of this year came to 2,003,545 tons, which compares with 2,168,339 tons for the corresponding period of last year.

Current Business.

There has been no development so far as the steam coal market is concerned. Prices have not materially altered, although in some instances prices have been taken which are really lower than have ever been accepted. This has happened more perhaps in isolated cases when the collieries have been placed in exceptional difficulties for the want of the clearance of wagons. Superior Admiralty large coals maintain a steady appearance and smalls keep their level. The inquiry for patent fuel is very slow. The same applies to coke. Pitwood is depressed owing to the restricted demand, as the result of the irregularity of work at the pits.

EDUCATIONAL INTELLIGENCE.

THE DORMAN-LONG TRAVELLING SCHOLARSHIP.—Members of the Institution of Structural Engineers are reminded that the competition for the Dorman-Long Travelling Scholarship, value £300, and Gold Medal, takes place on Saturday, May 12th, 1928. The competition is one in design, consisting of a preliminary sketch design for which twelve hours will be allowed, and which will be held under supervision at such centres as may be arranged. This preliminary competition will be followed by the design proper, which will have to adhere to the original sketches, and for which candidates will be allowed twenty-eight days. The competition is open to members (in any class) of the Institution, and there is no age limit. It will consist of the planning and design of a steel-frame building and the preparation of typical steel work details therefor. Full particulars and a form of entry may be obtained from the Secretary, the Institution of Structural Engineers, 10, Upper Belgrave-street, S.W. 1. The closing date for entries is Monday, May 7th.

CATALOGUES.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Pamphlet P219 on overhead equipment.

J. BLAKEBOROUGH AND SONS, Ltd., Brighouse, Yorks.—Folder dealing with Nuswift fire extinguishers.

EDGAR ALLEN AND Co., Ltd., Imperial Steel Works, Sheffield. Pamphlet entitled "Drilling, Tapping, Reaming, &c., with Perfect Alignment."

WILLIAM RAINFORTH AND SONS, Ltd., Lincoln.—Leaflet describing the "Polestar" system of refrigeration without machinery or motive power.

ROYAL INSTITUTION.—The Friday evening discourse on February 24th will be delivered by Professor George Gordon, on "The Lives of Authors," and on March 2nd by Sir Farquhar Buzzard, on "The Psychology of the Sick."

UNIVERSITY COLLEGE ENGINEERING SOCIETY.—The annual dinner of the Engineering Society of University College, London, will be held on Thursday, February 23rd, 1928, in the College Refectory, at 7.30 p.m. Mr. Roger Smith, Past-President of the Institution of Electrical Engineers and President of the Institute of Transport, will be in the chair. The hon. secretary at University College would be very glad to hear from old students who wish to be present.

THE MAENTWROG HYDRO-ELECTRIC POWER SCHEME.—We are desired to say, with regard to the Maentwrog hydro-electric power scheme, a brief preliminary description of which appeared in our issue of February 10th, that Boving and Co., Ltd., were the main contractors for the generating sets, the sub-contractor for the generators themselves being the English Electric Company, Ltd., and that the switchgear was supplied under another contract by A. Reyrolle and Co., Ltd.

BESSEMER GOLD MEDAL.—The Council of the Iron and Steel Institute has decided to award the Bessemer Gold Medal of the Institute for 1928 to Mr. Charles M. Schwab, of New York, chairman of the Bethlehem Steel Corporation and President of the American Iron and Steel Institute. It is expected that the medal will be presented to Mr. Schwab in person by Mr. Benjamin Talbot, President of the Institute, at the annual meeting at the Institution of Civil Engineers on May 3rd.

GRANTS FOR THE PROMOTION OF AERONAUTICS.—The Trustees of the Daniel Guggenheim Fund for the Promotion of Aeronautics have, for the second year in succession, made a grant of 5000 dollars to the Royal Aeronautical Society. The grant made in 1927 proved to be of great value to the Society, enabling it to extend its scope and influence. Many papers were published which would, without the grant from the Fund, have had to be held over, and a number of new branches were started. The Daniel Guggenheim Fund for the Promotion of Aeronautics was founded in 1925 by Daniel Guggenheim, of New York. The object of the Fund is exactly that stated by its title, and though it is American in its origin, its scope is world-wide. The gift of 10,000 dollars to a British Aeronautical Society is only one example of the broad outlook of the Trustees of the Fund. The Trustees have offered 150,000 dollars in prizes in a safe aircraft competition which is open to the whole world. The first five entries were received from British inventors. The full rules for the competition were published in the *Journal* of the Royal Aeronautical Society for June, 1927.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—On Thursday, February 9th, the annual dinner of the Institution of Electrical Engineers was held at the Hotel Cecil, when the President, Mr. Archibald Page, presided. Over 600 members and guests were present. In proposing the toast of "The Institution," Sir William Bragg said that the problems of the electrical engineer and scientist were singularly alike. Very important work had been done in the laboratories of electrical manufacturing concerns, and he had noted that work with feelings of admiration. Of all the problems that had to be solved that of discovering the true nature of magnetism appeared to be one of the most difficult. Practically nothing was known about magnetism. The microscope failed to reveal any change in iron subjected to a magnetising force, and the nature of magnetism was still a mystery. Replying to the toast, the President said that the Institution was a solid structure. It was impossible to keep abreast of all the branches of science, but he felt that they had the quality of enthusiasm. One of the bright spots in the industrial situation was the way in which British electrical manufacturers were expanding their export trade. The Central Electricity Board had just decided to place a heavy order for transformers entirely with British firms. Mr. Roger Smith proposed the toast of "Our Guests," and Sir Ralph Wedgood and Mr. W. E. Tyldesley Jones replied.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 10 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 7 6	3 7 6
Silicious Iron	3 7 6	3 7 6
No. 3 G.M.B.	3 5 0	3 5 0
No. 4 Foundry	3 4 0	3 4 0
No. 4 Forge	3 3 6	3 3 6
Mottled	3 3 0	3 3 0
White	3 3 0	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 4 6 to 3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 0 to 3 1 0	—
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 4 0 to 3 4 6	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0	—
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a); 4 5 0 (b); 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 7 6 to 10 5 0	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0	—
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 12 6	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
MANCHESTER—		
Bars (Round)	8 12 6	—
„ (Small Round)	7 10 0 to 7 15 0	—
Hoops (Baling)	10 5 0	10 0 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
„ (Lancs. Boiler)	10 5 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	—
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	9 10 0 to 10 10 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	6 0 0 to 6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 0 0 to 13 2 6	—
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	17/10½ to 18/1½
Block Tin (cash)	231 5 0
„ (three months)	233 15 0
Copper (cash)	61 18 9
„ (three months)	61 11 3
Spanish Lead (cash)	20 3 9
„ (three months)	20 15 0
Spelter (cash)	25 13 9
„ (three months)	25 13 9
MANCHESTER—	
Copper, Best Selected Ingots	66 15 0
„ Electrolytic	67 2 6
„ Strong Sheets	92 0 0
„ Tubes (Basis Price), lb.	0 1 1
Brass Tubes (Basis Price), lb.	0 1 0
„ Condenser, lb.	0 1 2
Lead, English	21 15 0
„ Foreign	20 10 0
Spelter	25 15 0
Aluminium (per ton)	£107

FERRO ALLOYS.

Tungsten Metal Powder	1/7½ per lb.
Ferro Tungsten	1/3 per lb.
	Per Ton. / Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 15 0 / 7/6
„ „ 6 p.c. to 8 p.c. „	£22 7 6 / 7/–
„ „ 8 p.c. to 10 p.c. „	£22 5 0 / 6/–
„ „ Specially refined	
„ „ Max. 2 p.c. carbon	£35 10 0 / 12/–
„ „ „ 1 p.c. carbon	£41 10 0 / 15/–
„ „ „ 0·70 p.c. carbon	£53 0 0 / 17/6
„ „ „ carbon free	1/1 per lb.
Metallic Chromium	2/11 per lb.
Ferro Manganese (per ton)	£13 10 0 for home; £13 10 0 for export
„ Silicon, 45 p.c. to 50 p.c.	£12 17 6 scale 5/– per unit
„ „ 75 p.c.	£20 10 0 scale 6/– per unit
„ Vanadium	14/3 per lb.
„ Molybdenum	5/– per lb.
„ Titanium (carbon free)	0/11½ per lb.
Nickel (per ton)	£175
Ferro-Cobalt	9/– per lb.

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/6
„ „ Ell	15/3
„ „ Splint	17/– to 17/6
„ „ Trebles	14/–
„ „ Doubles	13/6
„ „ Singles	11/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	15/6
„ „ Trebles	14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/3 to 12/6
Screened Navigation	18/–
Trebles	13/6 to 14/–
Doubles	13/3 to 13/6
Singles	11/3
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9
Secondary Steam	12/3
Trebles	13/6
Doubles	13/7
Singles	11/5

ENGLAND.

(8) N.W. COAST—	
Steams	24/– to 25/–
Household	37/6 to 50/–
Coke	23/6
NORTHUMBERLAND—	
Best Steams	13/3
Second Steams	11/9 to 12/–
Steam Smalls	10/–
Unscreened	11/9 to 12/–
Household	21/– to 27/–
DURHAM—	
Best Gas	15/6
Second	13/3 to 13/9
Household	21/– to 27/–
Foundry Coke	18/6 to 19/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/– to 20/6 —
Screened House Coal	16/– to 17/6 —
„ „ Nuts	15/– to 16/– —
Yorkshire Hards	14/6 to 15/6 —
Derbyshire Hards	14/– to 15/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/– to 7/– —
Smalls	3/– to 4/6 —
Blast-furnace Coke (Inland) 13/– at ovens	—
Furnace and Foundry Coke (Export), f.o.b.	17/– to 17/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/– to 19/6
Second Smokeless Large	18/6 to 19/–
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	17/– to 17/3
Western Valley Large	16/9 to 17/–
Best Eastern Valley Large	16/9 to 17/–
Ordinary Eastern Valley Large	16·3 to 16/9
Best Steam Smalls	12/6 to 13/–
Ordinary Smalls	11/– to 12/6
Washed Nuts	18/– to 23/–
No. 3 Rhondda Large	20/– to 20/6
„ „ Smalls	14/9 to 15/3
No. 2 „ Large	16/– to 16/6
„ „ Through	14/6 to 15/6
„ „ Smalls	12/6 to 13/6
Foundry Coke (export)	30/– to 37/6
Furnace Coke (export)	27/6 to 30/–
Patent Fuel	22/6 to 24/–
Pitwood (ex ship)	27/– to 27/3
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	30/– to 32/6
Seconds	28/6 to 29/–
Red Vein	20/6 to 25/–
Machine-made Cobbles	35/– to 40/–
Nuts	37/6 to 42/6
Beans	23/– to 27/–
Peas	17/– to 18/–
Breaker Duff	8/6 to 9/–
Rubbly Culm	9/– to 9/6
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	9/9 to 10/9
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Railways and Road Traction.

THE heavy deficit of the railway companies is directing attention to the increasing competition of road transport. The higher railway rates have brought home to users the economy and convenience of the motor lorry for the transport of goods, even over fairly long distances. Every advance in rates is followed by a decline in the railway goods traffic and an increasing use of motor vehicles. At first it was supposed that the heavy road vehicles would become useful adjuncts to the railways by serving as feeders over particular districts, but with the repeated increases in railway rates it has been found that the motor lorry can extend its sphere of operations. A typical instance may be given of a large engineering concern at Orleans which sends lorries to Paris overnight for the distribution and collection of goods the following day. The same thing is done by scores of firms over quite a large radius. The last census of motor lorries in this country showed that there were 267,476, and the number must have certainly increased since then. The rate of progression during the past seven years has been remarkable. Its ultimate development will depend upon the relative advantages in point of cost. If, as is threatened, the railway rates are again to be increased there will be more lorries on the road. The railways are only safe from motor vehicles for long distances, and even then they have to compete with inland waterways for the carriage of goods of considerable bulk.

Hot Bulb Engines.

One of the reasons that retarded the development of hot bulb engine construction in this country was the high scale of duties imposed on oil fuels, and it was only after the war, when the importance of prime movers of this type was fully recognised, that the duties were reduced sufficiently to encourage the use of gas, oil and similar fuels. Makers of such engines are therefore alarmed at the character of the new tariff which is now before the Chamber of Deputies, whereby the import duties on petroleum products are adjusted with a view to the development of the oil refining industry in France. There is to be a considerable reduction in the import duties on oils that are to be refined in this country, but as the loss of revenue from this source must be made good in other ways it is proposed to increase the duties on oil fuels to an extent that, it is affirmed, will practically eliminate all hope for the future of the heavy oil engine. Manufacturers of such prime movers are, therefore, making a vigorous protest against raising the duties on fuel oils and suggest that the deficit could be easily made good by a further small increase in the duties on lubricating oils.

Coal in Madagascar.

In a communication from the Minister of Colonies it is stated that discoveries recently made in Madagascar point to the existence of coal deposits of such magnitude as to warrant the belief that, in course of time, the Colony will become an important mining centre. The coal is bituminous and has a heat value of something like 7500 calories. So far six seams have been discovered at about 90 miles to the east of Tullear. They are of average thickness, and prospecting has shown that they continue with striking regularity over a considerable distance. It is estimated that the amount of coal available at a depth of not more than 500 m. is 1000 million tons, while, if the importance can be judged from the continuance of the geological formation in which they are found, the resources of coal in Madagascar are likely, it is said, to be "formidable." The Minister of Commerce naturally attaches considerable value to the discovery of this wealth of coal in a part of the colony which has always been regarded as destitute of natural resources.

The Motor Industry.

In the automobile industry the only firms the situation of which may be regarded as satisfactory are those which devote their attention largely to the commercial side, including rail motors, industrial power sets, tractors and other vehicles for the Colonies and even motor boats for colonial rivers. The business in touring cars is of a precarious nature, and notwithstanding the belief that the future lies in a "rationalisation" of the industry, all efforts to attain that result have so far failed. The grouping of the interests of Delahaye, Unic, Chenard and Walcker and Delage with the idea of fixing upon the types of cars to be constructed by each, and of bringing down production costs by centralising purchases of raw material, had to be abandoned after less than a year's trial. The principle of "rationalisation" is approved of in France, but there are almost insuperable difficulties in the way of putting it into practice. After a long period of negotiation, during which German interests sought to obtain control of the business, the De Dion-Bouton company has been refloated with a purely French Board of directors, and it is hoped that this pioneer of the automobile industry will once more resume the position it occupied formerly.

Import Duties.

As the new Tariff Bill will not be introduced into the Chamber of Deputies before the reassembling of Parliament after the elections, and may be further delayed a considerable time, the Government found it necessary to present a new Bill for immediate discussion whereby the import duties on certain metallurgical and other products will be raised in view of the right which was conferred on Germany by the treaty of August last to benefit from the minimum tariff on all goods in December next, whether the Tariff Bill is passed or not. It has therefore been decided to raise the minimum on all products which, if admitted from Germany under the present scale, would, it is alleged, have a disastrous effect upon home industries. The Government affirms that the proposed new duties are not excessive.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

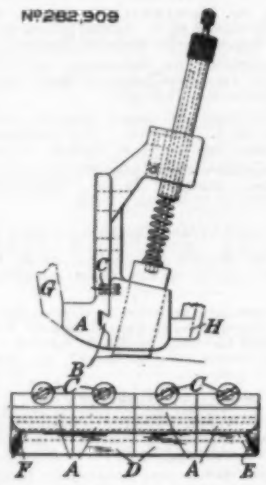
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

282,909. October 5th, 1926.—IMPROVEMENTS IN AND CONNECTED WITH BRUSH HOLDERS FOR DYNAMO-ELECTRIC MACHINES, The English Electric Company, Ltd., of 28, Kingsway, London, W.C. 2; and Ernst Heinrich Hermann Hassler, of Siemens Works, Stafford.

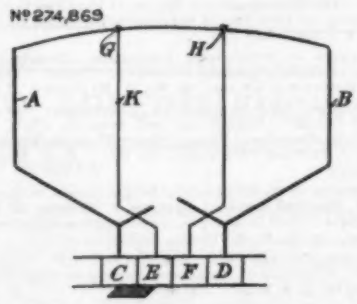
According to this invention, the brush holders of electrical machines are provided with arcing blocks which act as shields to protect the holders from the detrimental effects of arcs. These arcing blocks are indicated at A. For the purpose of holding them in position the brush holders are provided with a



dovetail rib B and the blocks A have corresponding recesses. The attachment carrying the arcing blocks is held in position by screws C. The arcing blocks associated with the two middle brush holders are rounded off symmetrically as indicated at D, but the right and left-hand blocks are rounded off unsymmetrically as at E and F, so that there are no sharp corners at the ends. The parts G and H are portions of shields of arc-resisting material and the arcing blocks and these shields combine to separate the brush gear from the commutator.—*January 5th*, 1928.

274,869. July 19th, 1927.—IMPROVEMENTS IN OR RELATING TO COMMUTATOR WINDINGS FOR DYNAMO ELECTRIC MACHINES, *International General Electric Company, Incorporated, of 120, Broadway, New York.*

The object of this invention is to improve commutation. The main conductors A B of the armature winding are connected to the segments C D of the commutator while auxiliary bars E and F, likewise situated in slots, are connected on the one hand to intermediate points G H of the end connections, and on the

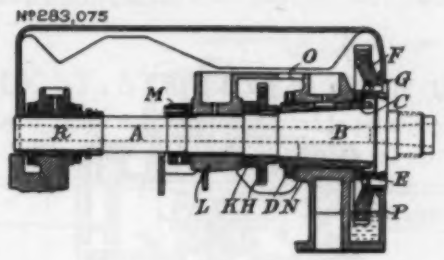


other hand to intermediate segments E F. By the arrangement of the two intermediate bars, the short-circuit current beneath the brushes is reduced to less than one-third of its original value. If, in the example shown, the brushes are constructed so as to cover at least two commutator segments, then the auxiliary bars can be made with a smaller cross-section. In this case the short-circuit current flows, for example, in the circuit A K, and gradually diminishes while the main current flows essentially only in the main conductor A.—*January 12th*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

283,075. June 29th, 1927.—IMPROVEMENTS IN SPINDLE GEARS AND BEARINGS FOR LATHES AND LIKE MACHINES, Machine-tool Works Oerlikon, of 37, Industriestrasse, Oerlikon, near Zurich.

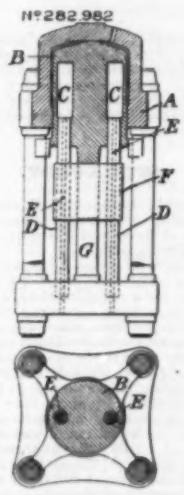
According to this invention, a spindle having a main bearing and a thrust bearing has two gear wheels, of different sizes, fixed to it, in front of and behind the main bearing respectively, the larger one being fixed to a collar on the spindle, leaving the spindle head entirely free for fixing a chuck of any appropriate kind, and the smaller gear wheel being between the main bearing and the thrust bearing, which are connected to each other by a cover common to both. The spindle A has a coned gudgeon B within a cylindrical undivided bush C mounted in the main bearing, screw rings D and E being provided for adjusting the bush. The large gear wheel F is fixed to a collar G of the spindle outside the main bearing, and the smaller gear wheel H is keyed to the spindle directly on the other side of the main bearing, with the step bearing K, which is a ball bearing, against it. One of the ball races abuts against a thrust block L which is adjustable by means of a screw ring M. The main bearing N and the thrust block L are joined by a cover O so that they constitute a single



member of considerable strength. A cover P encloses the larger wheel, with an oil sump or bath in which this wheel runs. The rear gudgeon R works in another bearing. It will be seen that the spindle head is left quite clear to accommodate chucks.—*January 5th*, 1928.

282,982. January 3rd, 1927.—IMPROVEMENTS RELATING TO HYDRAULIC PRESSES, Serck Radiators, Ltd., and Oscar Serck, both of Warwick-road, Greet, Birmingham.

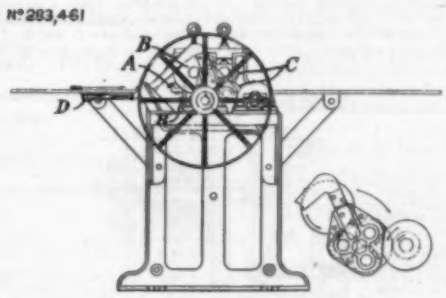
The illustration shows the invention applied to an extension press having the main cylinder or head A mounted at the upper end of the usual columns. The main ram B is provided with pockets C which serve as auxiliary cylinders containing auxiliary plungers D, which are secured to the bed. On the operative



stroke of the main ram B the auxiliary cylinders C slide over the auxiliary plungers, any fluid within the cylinders C being displaced by way of conduits. The return stroke of the ram B is effected by the release of the hydraulic pressure in its cylinder and the admission of pressure by way of the central apertures E to the cylinders C. The plungers also act as guides. The part F slides over the hollow stem G which supports the die.—*January 5th*, 1928.

283,461. November 9th, 1927.—A MACHINE FOR SEPARATING METAL PLATES, D. J. Rees, Arcol Works, Maryland-road, Pontymister, Mon.

This machine is intended to separate tin-plate sheets which have become stuck together in the process of rolling. The separation is effected by drawing the plates over the knife A by



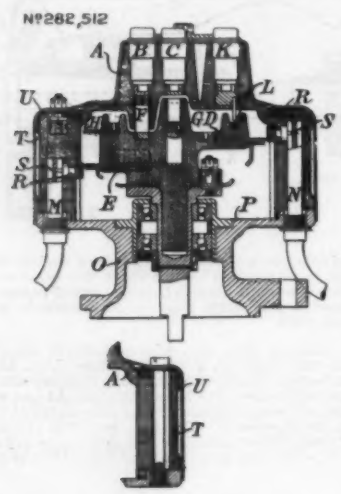
means of the two pairs of rolls B B and C C in the direction shown by the arrow. The drive for the rolls is transmitted through three pinions mounted in a pivoted housing in such a manner that by operating the hand lever D their direction of rotation may be reversed and the plates returned to the feed table if necessary on account of tearing or any other mishap.—*January 12th*, 1928.

MOTOR CARS AND ROAD TRAFFIC.

282,512. October 5th, 1926.—IMPROVEMENTS IN AND RELATING TO DISTRIBUTORS FOR MAGNETO-ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2; Ernest George Parrott, of Prescott House, Kenilworth; and Joseph Harold Pollard, of 98, Mayfield-road, Coventry.

The improvements described in this specification are applicable more particularly to magneto distributors in which the ignition leads are secured in grooves around the distributor moulding. One of the objects is to simplify the wiring and to shorten the cables. Another special feature relates to securing the axial leads in the grooves on the periphery of the distributor moulding by means of a moulded sleeve. The high-tension metal-braded supply leads are brought out from the magneto to the distributor moulding at terminals B and C and are adapted to make contact with nickel electrodes D and E in the distributor brush

holder by means of jump spark electrodes or carbon brushes F and G. A starting electrode carried by the distributor moulding is shown at H, current being led to this electrode from the magneto by way of the terminal K and the ring L. The metal-braded ignition cables M and N are brought out from the distributor head at the flange end of the main casing O. The brading of these cables terminates at the casing O and is earthed



to a flange P. The leads M and N are placed axially in grooves around the periphery of the distributor moulding A and contact is made with the segments R of the distributor by means of spike connections S. A moulded sleeve T is placed over the moulding A after all the leads have been put into position, whilst a metal shield U is placed over the distributor.—*December 29th*, 1927.

METALLURGY.

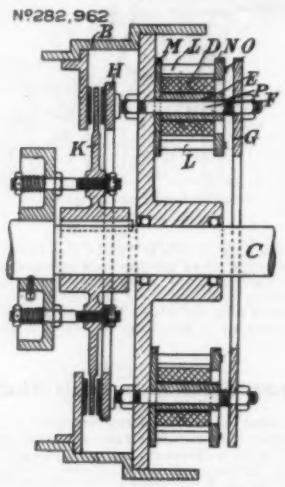
283,288. October 26th, 1926.—THE ELECTRO-DEPOSITION OF METALS, H. Webb, 20, Seymour-street, Euston, London, N.W. 1, and S. O'Brien and Partners, Ltd., 66, Victoria-street, City of Westminster.

This specification gives a recipe for nickel-plating aluminium as follows:—(1) The articles are immersed in a boiling bath of caustic soda solution for a requisite time, *e.g.*, one-half minute to one and one-half minute according to thickness of the aluminium. (2) They are then taken out and immersed in a bath of commercial nitric acid, for about one-half minute. (3) They are immediately afterwards passed through a 5 per cent. bath of sulphuric acid. (4) Directly out of the acid they are transferred to the plating bath consisting of a solution of usual nickel salt or salts, acidified by about four fluid ounces of sulphuric acid to approximately 280 gallons of solution, and arranged for the electro-deposition of nickel by connecting the articles to the cathode. Two hours or thereabouts is an appropriate period for this step. (5) The articles are dried in sawdust. (6) The dried articles are buried in fine silver sand contained in suitable pans, and placed in an oven of a suitable nature whereby the heat is directed all around the pan or pans. For aliminium the temperature in the oven is in the region of 280 deg. Cent. and the duration of heating is important. So far it has been found that for plates of one-sixteenth inch thick—or articles composed mainly of this gauge aluminium—the heating period should be about three and one-half minutes; for ⅛in. gauge the period is seven minutes, and so on proportionally. This period, however, and its variation in regard to different gauges, remains to be definitely determined. Possibly, a different heating point would be required for different metals.—*January 9th*, 1928.

MISCELLANEOUS.

282,962. December 3rd, 1926.—IMPROVEMENTS IN MAGNETICALLY ACTUATED FRICTION CLUTCHES, Malcolm Walker, of 303, Paisley-road West, Glasgow, S.W.

The clutch comprises a friction surface carried by one of the parts to be coupled together, as, for example, upon a stepped pulley or fly-wheel B freely mounted on the shaft C, the pulley or fly-wheel B supporting the electro-magnets D which are arranged equidistant from each other and from the axis of the



shaft. The central core or pole member E of each magnet is made hollow to receive a central movable rod or spindle F attached at one end to a ring G which forms the armature of the magnets. At its other end the spindle is attached to a ring H which forms the movable friction element. The stationary and movable friction elements respectively co-operate as usual with an intermediate friction disc K slidably keyed upon the shaft. Springs P serve to disengage the clutch parts when the magnets are not energised. Each magnet is provided, in addition to its central core or pole member E, with a series of outer pole members L consisting of rods or studs extending from the pole shoe M of the central core E to form a cage or grid around the magnet. The outer pole members L of each magnet may be connected together at their ends by a ring N. The pole members E of some or all of the magnets or the rings N may carry non-magnetic buttons or studs O to form stops for the armature and thus ensure an air gap between each magnet and the armature at all times.—*January 5th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME AND PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ILLUMINATING ENGINEERING SOCIETY.—Visit to the Home Office Industrial Museum, Horseferry-road, London, S.W. 1. 4 p.m.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, London, E. 1. Annual general meeting. 6.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Annual general meeting. Paper "Waste Heat Recovery," by Major W. Gregson. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecture and technical film, "Oil Production," by Mr. St. John Plevins. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The University: Its Ideals and its Problems," by Rev. E. M. Walker. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, Glasgow. Paper, "Engineering Tests for Cast Iron," by Mr. J. G. Pearse. 7 p.m.

SATURDAY, FEBRUARY 18TH.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, London, E. 1. Junior Section social gathering and dance. 7.11 p.m.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Newcastle-upon-Tyne. Papers: "Electric Mine Lamps and Better Lighting," by Mr. W. Maurice; and "A New Gas Detecting Miners' Electric Lamp," by Professor W. M. Thornton. 2.30 p.m.

MONDAY, FEBRUARY 20TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lecture, "Engineering Difficulties and Progress in the Design of Electric Cookers," by Mr. C. E. Allsopp. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "Engineering Inspection," by Mr. D. P. Muirhead. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Graduates' Section meeting. Informal discussion on "The Relative Importance of Sales, Design, and Works Organisation in Engineering." 6.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Canton Lecture, "Fatigue Phenomena, with Special Reference to Single Crystals," by Dr. Herbert John Gough. 8 p.m.

THE RAILWAY CLUB.—25, Tothill-street, London, S.W. 1. Annual general meeting, followed by Presidential address. 7.30 p.m.

MONDAY TO FRIDAY, FEBRUARY 20TH TO MARCH 2ND.

BRITISH INDUSTRIES FAIR.—Castle Bromwich, Birmingham, and at the White City, London.

TUESDAY, FEBRUARY 21ST.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Lecture, "The Development of Transport Facilities in the Midlands During the First Part of the Nineteenth Century," by Professor J. F. Rees. 5.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry graduates' meeting. Paper, "The Four-cylinder Motor Cycle Engine," by Mr. W. M. Heynes. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Engineering and Scientific Club, Queen-street, Wolverhampton. Paper, "Some Notes on Reorganising a Works to Increase Production," by Mr. C. R. F. Engelbach. 7.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—At 39, Elmbank-crescent, Glasgow. "Fatigue of Metals: Some Effects of Cold Drawing on the Strength and Endurance of Mild Steel," by Dr. R. M. Brown. 7.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Methods of Mechanical Testing at High Temperatures," by Mr. S. A. Main. 7.30 p.m.

THE INSTITUTION OF ELECTRICAL ENGINEERS, SCOTTISH CENTRE, and THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.—Joint meeting in the Freemasons' Hall, George-street, Edinburgh. Public lecture on "Rugby Radio Station," will be given by Mr. E. H. Shaughnessy, at 7.30 p.m.

WEDNESDAY, FEBRUARY 22ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Birmingham Graduates' visit to the works of A. J. Stevens and Co., Ltd., Penn-road, Wolverhampton. 2.30 p.m.

THURSDAY, FEBRUARY 23RD.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "Insulating Oils for High-voltage Cables," by Messrs. T. N. Riley and T. R Scott. 6 p.m.

JOINT DELEGATION OF THE YORKSHIRE ASSOCIATIONS OF THE INSTITUTIONS OF CIVIL, MECHANICAL, ELECTRICAL, MUNICIPAL AND COUNTY, AND LOCOMOTIVE ENGINEERS.—Great Northern Hotel, Leeds. Third annual dinner. 6.30 for 7 p.m.

FRIDAY, FEBRUARY 24TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Westminster, London, S.W. 1. Report on Heavy Oil Engine Working Costs.

ELECTRICAL POWER ENGINEERS' ASSOCIATION: MIDLAND DIVISION.—Chamber of Commerce, New-street, Birmingham. Lantern lecture, "Modern Metering Practice," by Mr. E. Fawsett. 7.15 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: LONDON STUDENTS' SECTION.—Savoy-place, Victoria Embankment, London, W.C. 2. "Salesmanship and its Application to Engineering," by Mr. F. C. Dain. 6.15 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Inspection of Public Service Vehicles," by Major Vernon C. Brook. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Exhibition of industrial cinematograph films. 7 p.m.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS.—Room D, Central Hall, Westminster, London, S.W. 1. Lecture, "Admiralty Floating Docks," by Mr. S. V. Goodall. 5.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecture, "The Applications of Electro-chemical Deposits of Metals to Engineering," by Mr. C. H. Faris. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. Paper, "The Mitchell Crankless Engine," by Messrs. G. U. L. Sartoris and K. Watson. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The Lives of Authors," by Professor George Gordon. 9 p.m.

WEST BROMWICH ENGINEERING SOCIETY.—Technical College, West Bromwich. Paper, "Power Factor and its Correction," by Dr. R. D. Gifford. 7.30 p.m.

SATURDAY, FEBRUARY 25TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, JUNIOR SECTION.—Winn's Café, Corporation-street, Manchester. Social gathering. 6 p.m.

MONDAY, FEBRUARY 27TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Fatigue Phenomena, with Special Reference to Single Crystals," by Dr. Herbert John Gough. 8 p.m.

WEDNESDAY, FEBRUARY 29TH.

ENGINEERING GOLFING SOCIETY.—Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. Annual general meeting. 12.30 p.m.

NEWCOMEN SOCIETY.—The Wellcome Historical Medical Museum, 54a, Wigmore-street, London, W. 1. Inspection of the Museum. 5.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Industry Fifty Years Hence," by Mr. Archibald Crawford. 8 p.m.

CONTRACTS.

VICKERS-ARMSTRONGS Ltd. has received an order for four "O" class submarines for the British Admiralty.

THE BRITISH POWER RAILWAY SIGNAL COMPANY, Ltd., has received from the Egyptian State Railways an order for a large number of mechanical signal fittings, including lattice signal posts and fittings, facing point locks, &c.

MIRRLEES BICKERTON AND DAY, Ltd., of 7, Grosvenor-gardens, Westminster, S.W. 1, have received from John I. Thornycroft and Co., Ltd., an order for a six-cylinder 600 B.H.P. "Mirrlees-Diesel" oil engine for the Diesel power station at their Basingstoke works.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., have received an order for a steam-driven oil tanker for the Vacuum Oil Company, Ltd. The vessel will be 385ft. in length and is designed to carry 7250 tons deadweight on a draught of 24ft. 4in. This is the 157th oil tanker to be built by the company.

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1920), Ltd., has received an order from the Thorncliffe Coal Distillation, Ltd., Sheffield, to build an entirely new central coke oven works at Smithywood, near Sheffield. The installation, which will consist of a battery of fifty-nine Becker ovens, 40ft. 8in. long by 12ft. 6in. high by 16in. wide, is to be capable of coking approximately 1300 tons of coal slack per day. It will comprise a semi-direct recovery plant for the production of neutral sulphate of ammonia, a tar plant, a benzol plant, coal-handling and screening plants, steam-raising plant, and all necessary railway sidings and roadways.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. C. B. KAY, the general works manager of the Sunbeam Motor Car Company, Ltd., has been appointed to a seat on the board of directors of that company.

MR. G. W VOLCKMAN, M. Inst. C.E., is on his way to India to take up the appointment of chief engineer and representative in India and the East of Sir Alexander Gibb and Partners, *vice* Mr. C. G. Stileman, M. Inst. C.E., who has had to resign the position on medical advice.

AUTOMATIC AND ELECTRIC FURNACES, Ltd., of Elecfurn Works, North-road, Holloway, London, N. 7, asks us to announce that Alfred Herbert, Ltd., of Coventry, has been appointed sole selling agent for Wild-Barfield electric furnaces in the Republics of the Argentine, Paraguay and Uruguay.

MR. E. W. DOREY, A.M.I.E.E., asks us to announce that he has moved his offices from Norwich House, Southampton-street, High Holborn, W.C. 1, to Avenue Chambers, Vernon-place, Southampton-row, London, W.C. 1. Telephone number, Holborn 7072; telegraphic address, "Condensity, Westcent, London."

THE TELEGRAPH CONDENSER COMPANY, Ltd., asks us to state that it has moved its offices from Norwich House, Southampton-street, High Holborn, W.C. 1, to Avenue Chambers, Vernon-place, Southampton-row, London, W.C. 1. Telephone number, Holborn 7072; telegraphic address, "Condensity, Westcent, London."

THE NEWALL ENGINEERING COMPANY, of Blackhorse-lane, Walthamstow, London, E. 17, has drawn our attention to a paragraph which recently appeared in an engineering journal and in which it was stated that the plant of the Newall Engineering Company, together with the plant of Peter Hooker, Ltd., was being disposed of. That paragraph, we are asked to state, has created an altogether wrong impression. Although certain of the Newall Company's plant went on to the market with the main plant of its former proprietor, Peter Hooker, Ltd., the business of the Newall Company, including the goodwill, the stocks of finished and partly finished gauges and measuring instruments, and the machines specially developed for gauge manufacture, have been purchased by a former official of the Newall Company. We are further requested to announce that not only is the business of the Newall Engineering Company being carried on, but that all the technical and operative staff has been retained.